US008028986B2

(12) **United States Patent**
Koga et al.

(10) **Patent No.: US 8,028,986 B2**
(45) **Date of Patent: Oct. 4, 2011**

(54) **GEARS FOR MANUFACTURING PRINTER, METHOD OF USING THE GEARS, AND THE PRINTER**

(75) Inventors: **Yuji Koga**, Nagoya (JP); **Daisuke Kozaki**, Nagoya (JP)

(73) Assignee: **Brother Kogyo Kabushiki Kaisha**, Nagoya-shi, Aichi-ken (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 819 days.

(21) Appl. No.: **11/615,663**

(22) Filed: **Dec. 22, 2006**

(65) **Prior Publication Data**

US 2008/0012206 A1 Jan. 17, 2008

(30) **Foreign Application Priority Data**

Dec. 29, 2005 (JP) 2005-380644

(51) **Int. Cl.**
B65H 5/00 (2006.01)

(52) **U.S. Cl.** **271/10.01**; 271/114

(58) **Field of Classification Search** .... 271/10.01, 271/10.09, 10.1, 114, 9.01; 74/341, 342, 74/354, 473.36, 473.37, 384, 421 R, 421 A
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

794,464	A *	7/1905	Parker	....	74/333
855,068	A *	5/1907	Parker	....	74/333
5,841,450	A	11/1998	Kawamura		
6,105,450	A *	8/2000	Sasaki et al.	....	74/421 A
2004/0124575	A1 *	7/2004	Lee et al.	....	271/10.01
2005/0195246	A1	9/2005	Ogawa		
2006/0071389	A1	4/2006	Kozaki et al.		

* cited by examiner

Primary Examiner — Stefanos Karmis
Assistant Examiner — Thomas Morrison
(74) *Attorney, Agent, or Firm* — Baker Botts L.L.P.

(57) **ABSTRACT**

A printer having a switch gear, first driven gear and second driven gear. The switch gear has a spur gear and is slidable along a direction that is parallel to a rotation axis of the spur gear. The first driven gear has a first spur gear and a cylinder fixed to the first spur gear. The cylinder is concentric with respect to the first spur gear and extends along the above direction. A hole is formed on the second driven gear. The hole is concentric with respect to a second spur gear and extends along the above direction. The second driven gear is rotatably mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear. The switch gear slides between a first position for engagement with the first driven gear and a second position for engagement with the second driven gear along the above direction. Since the driven gears are formed in this way, the position of the first driven gear in the above direction is not changed even when the second driven gear is not provided.

10 Claims, 26 Drawing Sheets

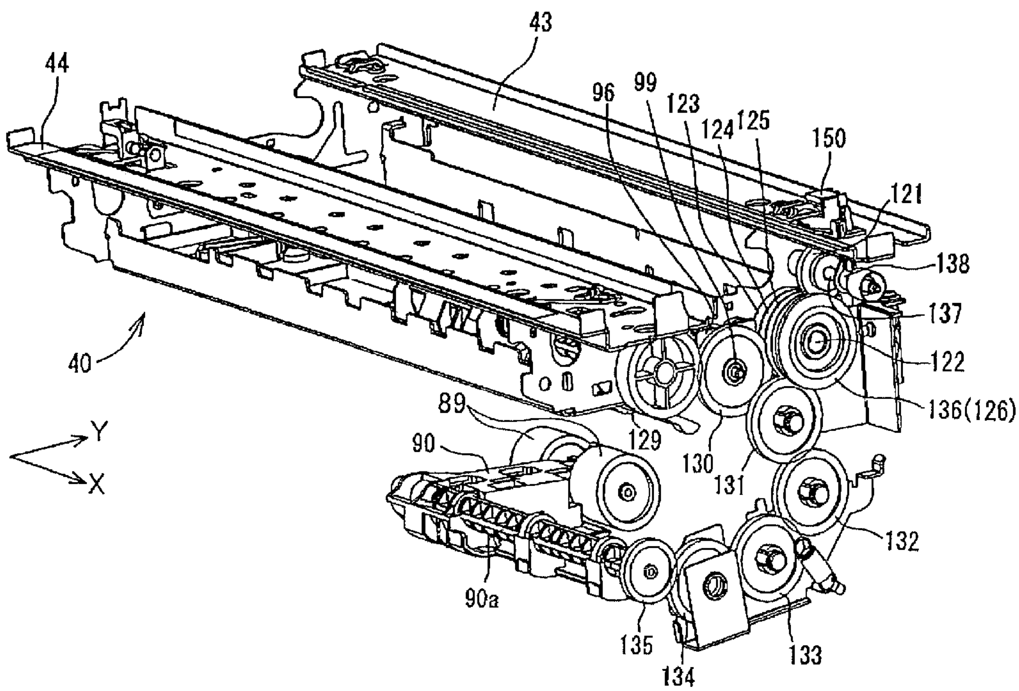


FIG. 1

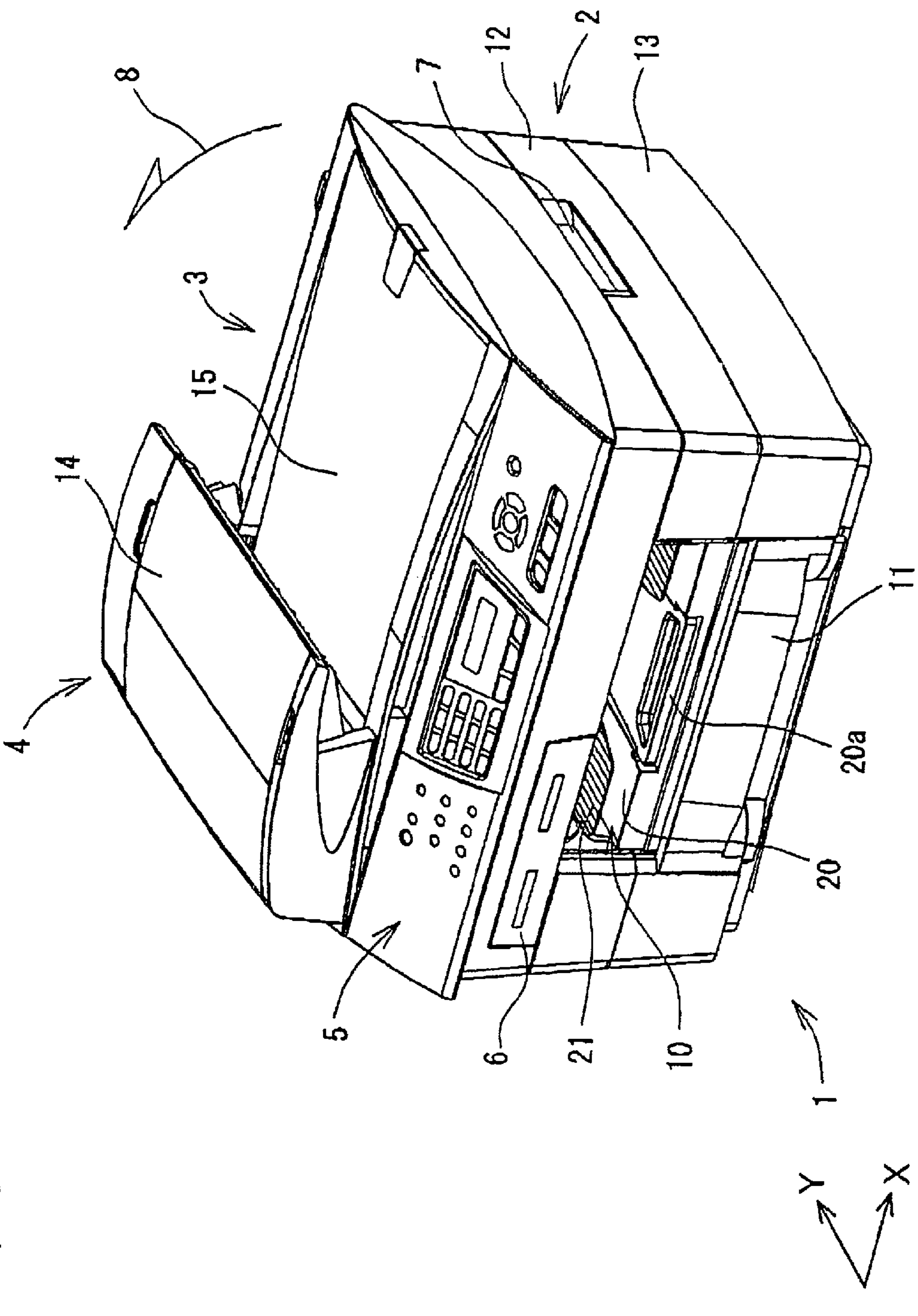
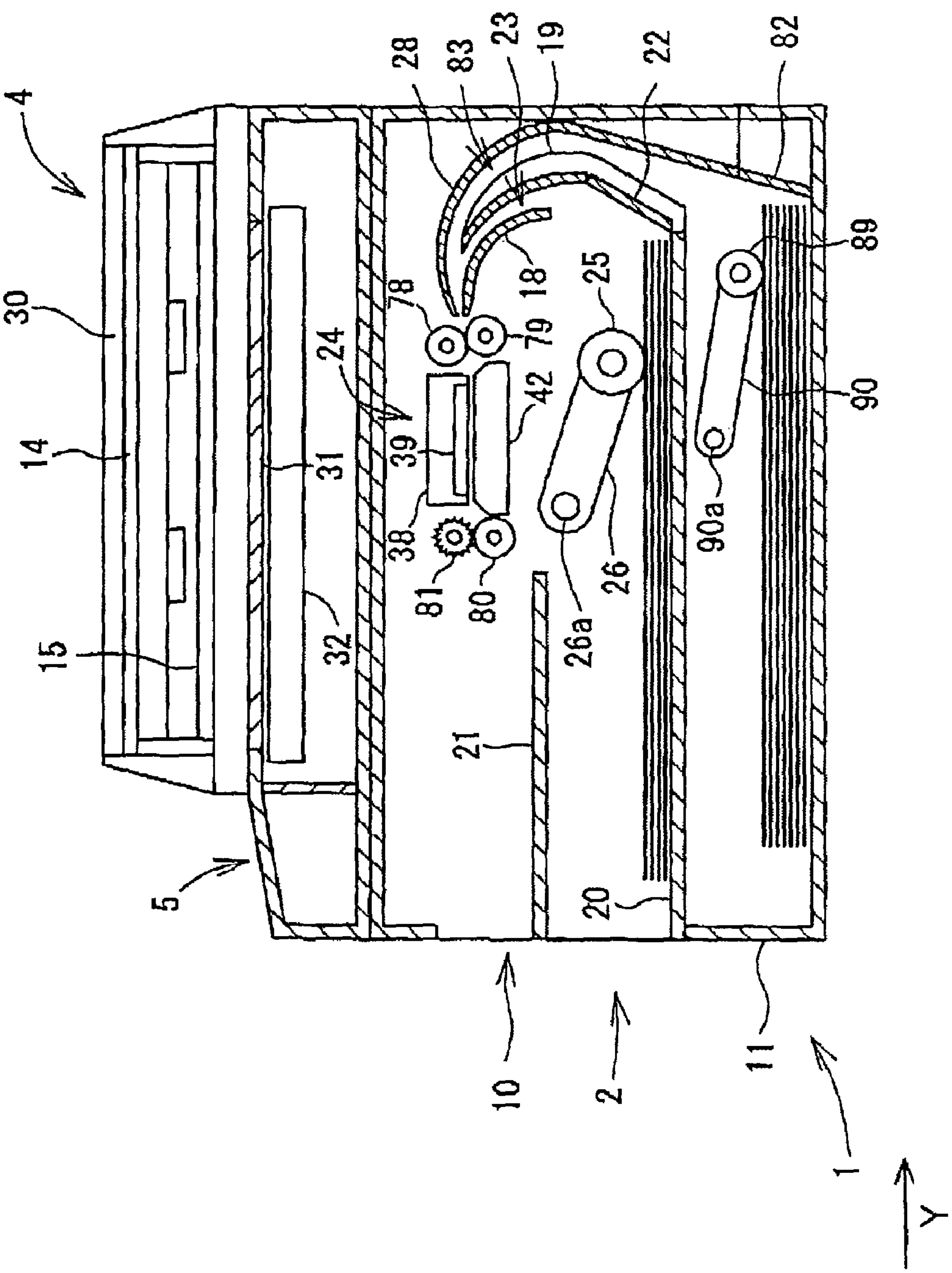


FIG. 2



4
30
14
15
5
31
32
24
39
38
81
80
78
79
42
28
83
23
19
22
82
18
25
26
26a
21
20
89
90
90a
10
2
11
1
Y

FIG. 3

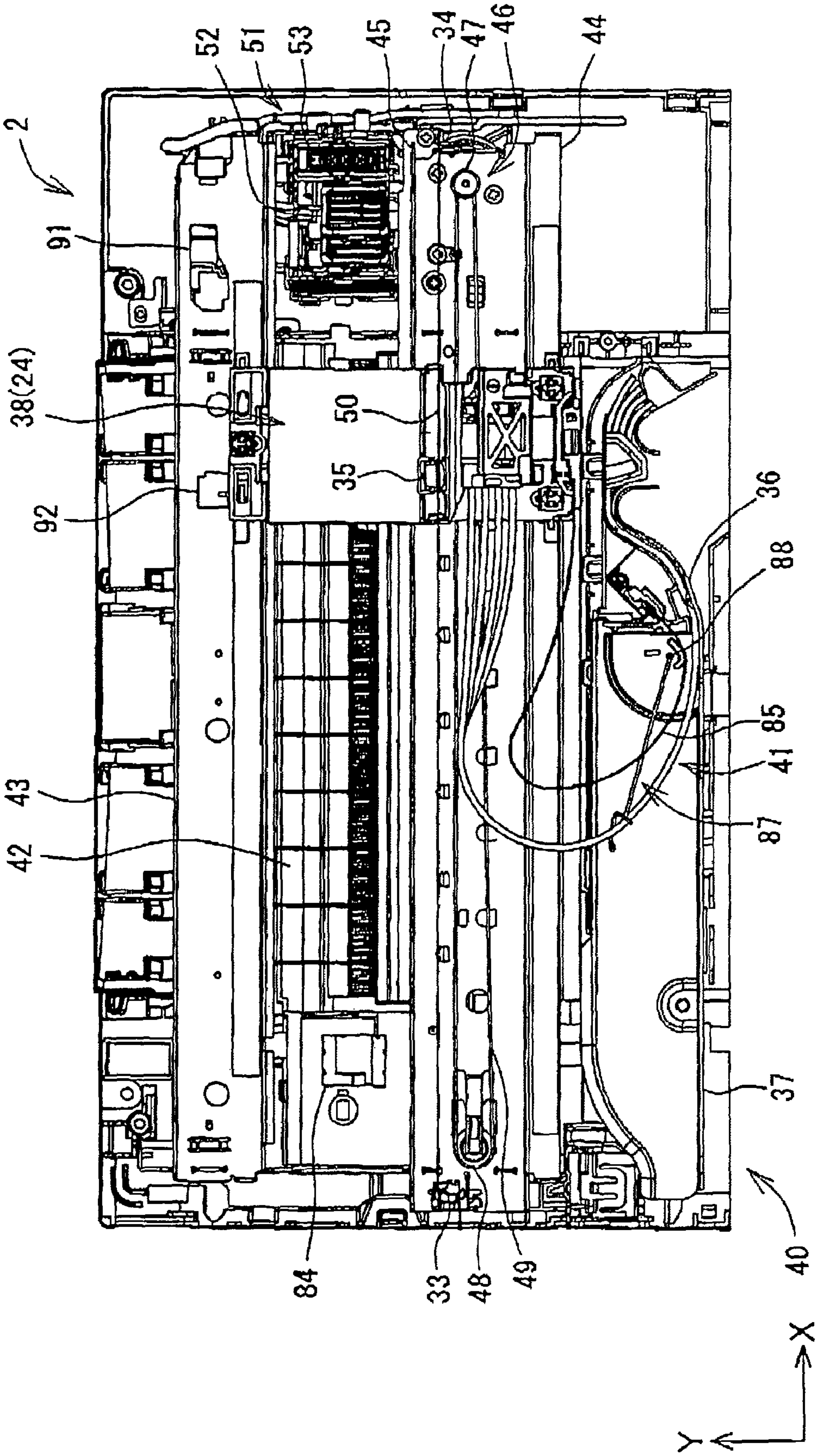

2
52
51
53
45
34
47
46
44
91
38(24)
50
35
92
36
88
85
41
87
43
42
37
84
33
48
49
40
X
Y

FIG. 4

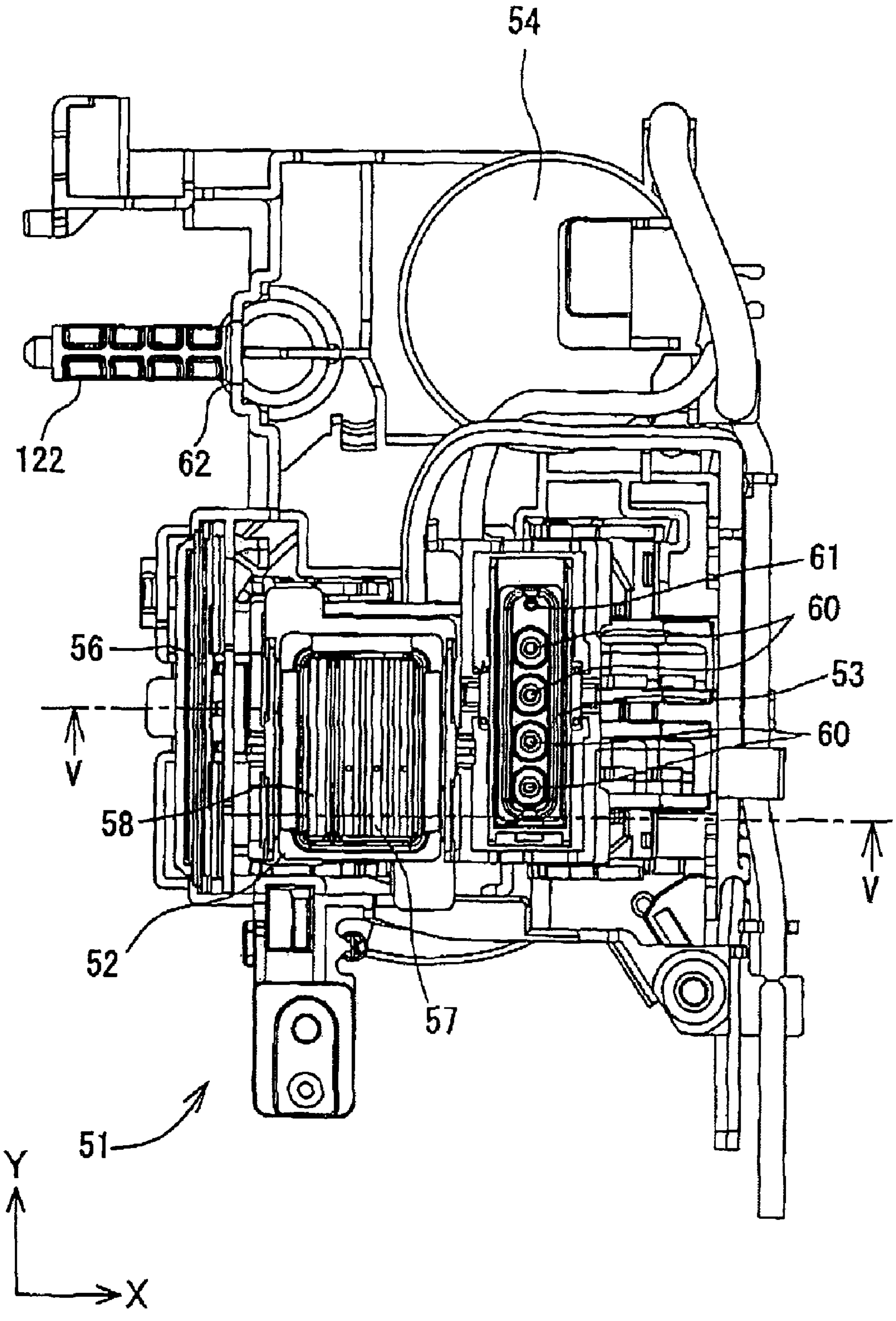


FIG. 5

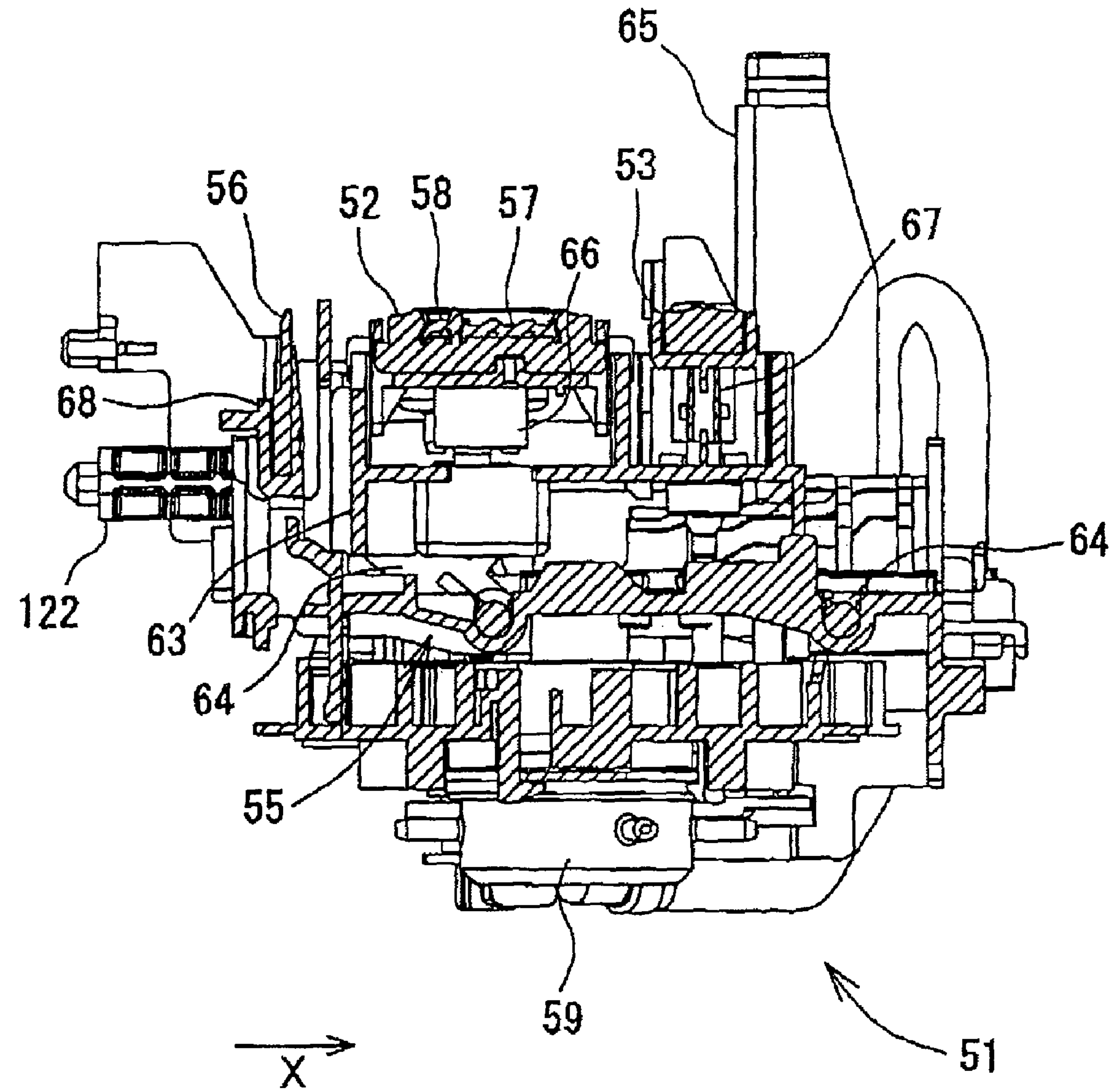


FIG. 6

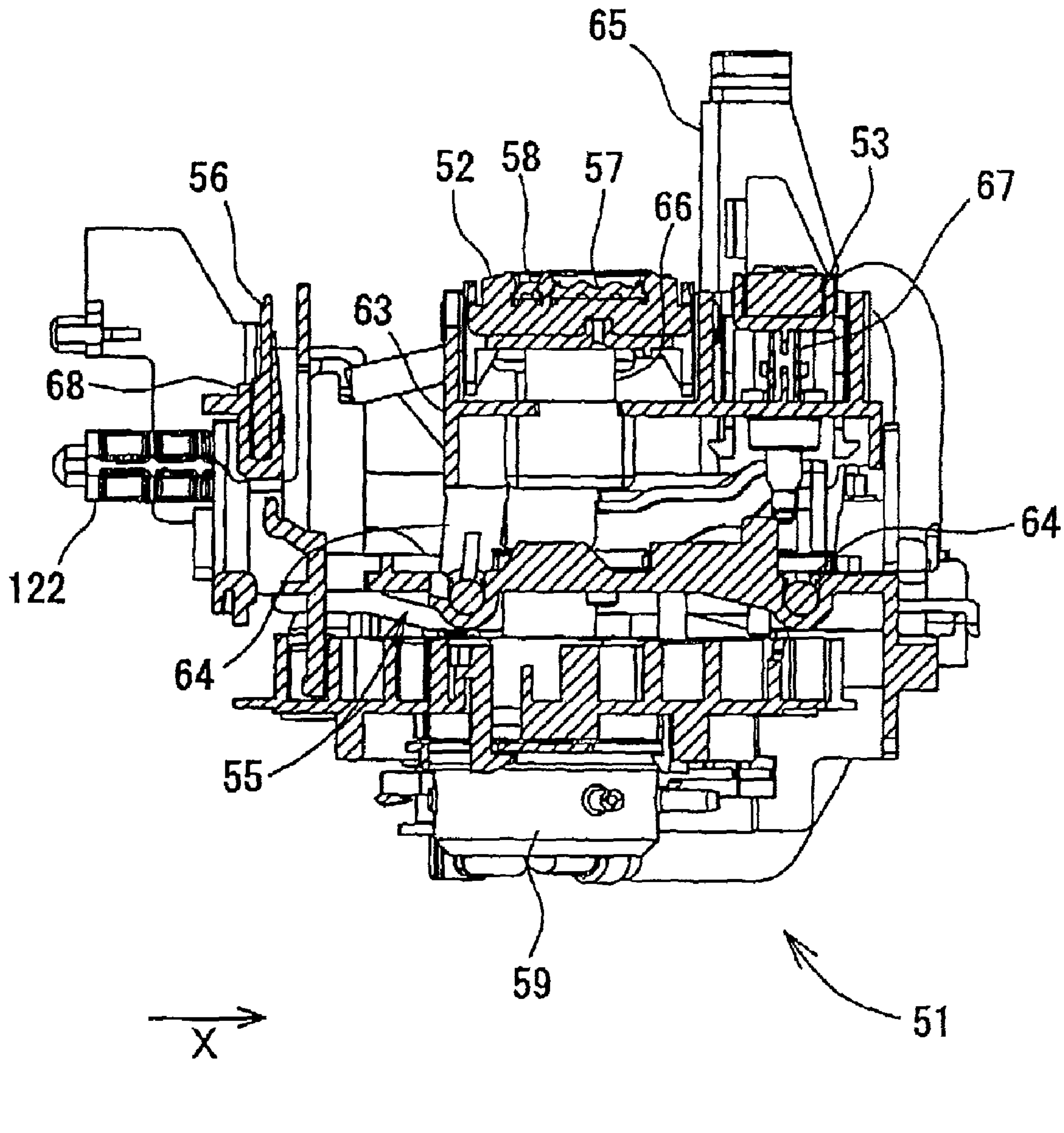


FIG. 7

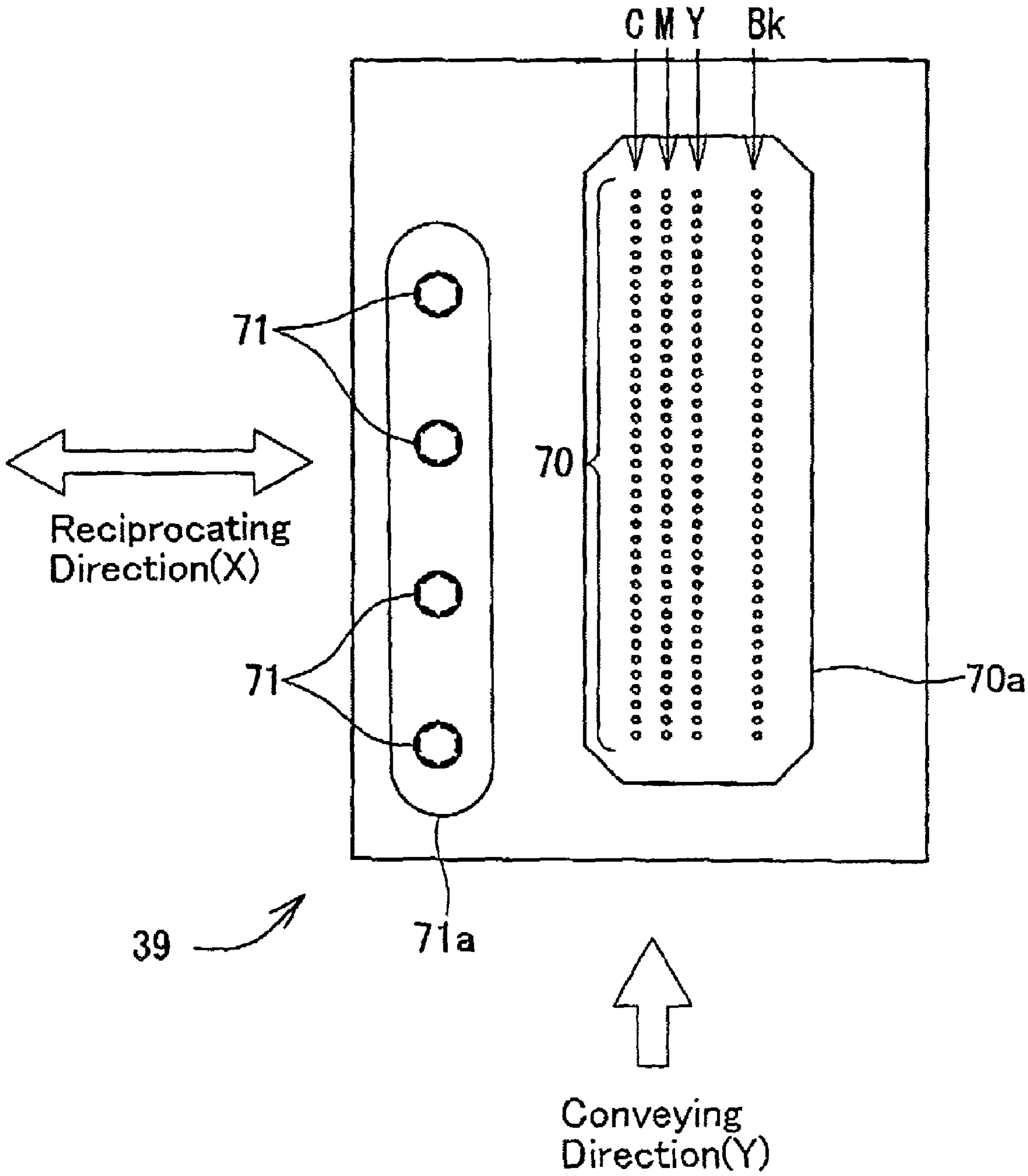

C M Y Bk
71
71
70
70a
71a
39
Reciprocating Direction(X)
Conveying Direction(Y)

FIG. 8

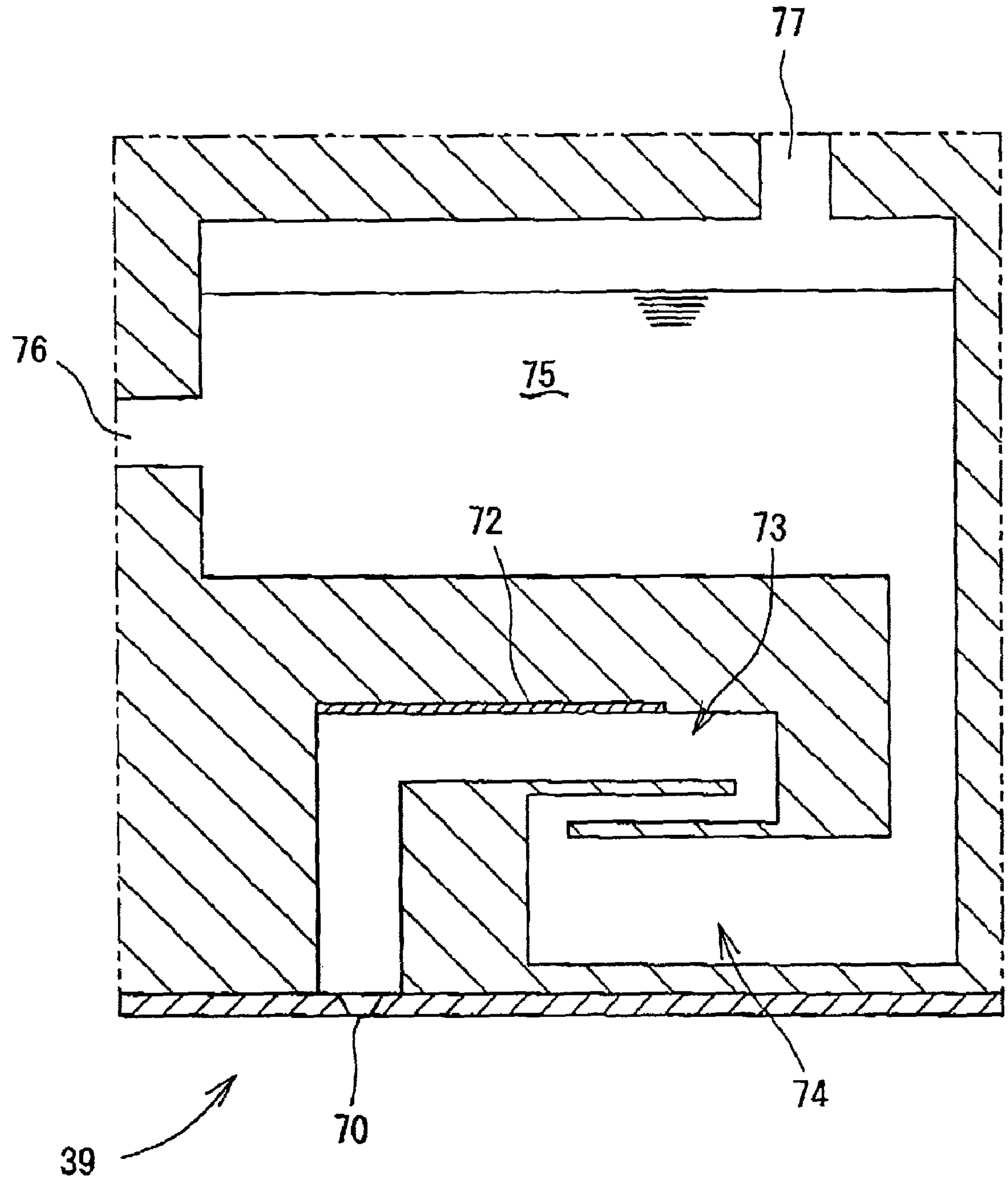
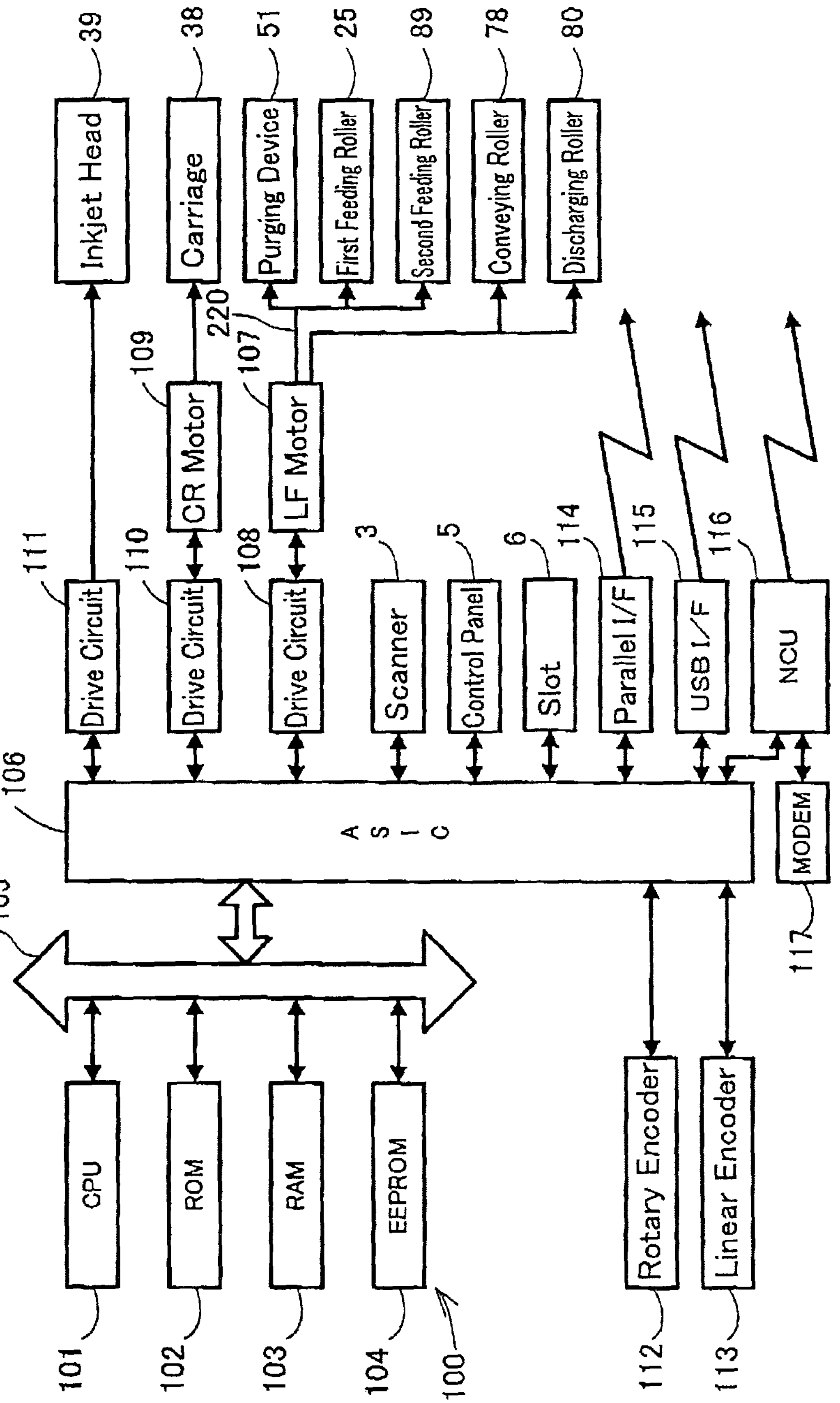


FIG. 9


Inkjet Head
Carriage
Purging Device
First Feeding Roller
Second Feeding Roller
Conveying Roller
Discharging Roller
CR Motor
LF Motor
Drive Circuit
Drive Circuit
Drive Circuit
Scanner
Control Panel
Slot
Parallel I/F
USB I/F
NCU
ASIC
MODEM
CPU
ROM
RAM
EEPROM
Rotary Encoder
Linear Encoder
39
38
51
25
89
78
80
220
109
107
111
110
108
3
5
6
114
115
116
106
105
117
101
102
103
104
100
112
113

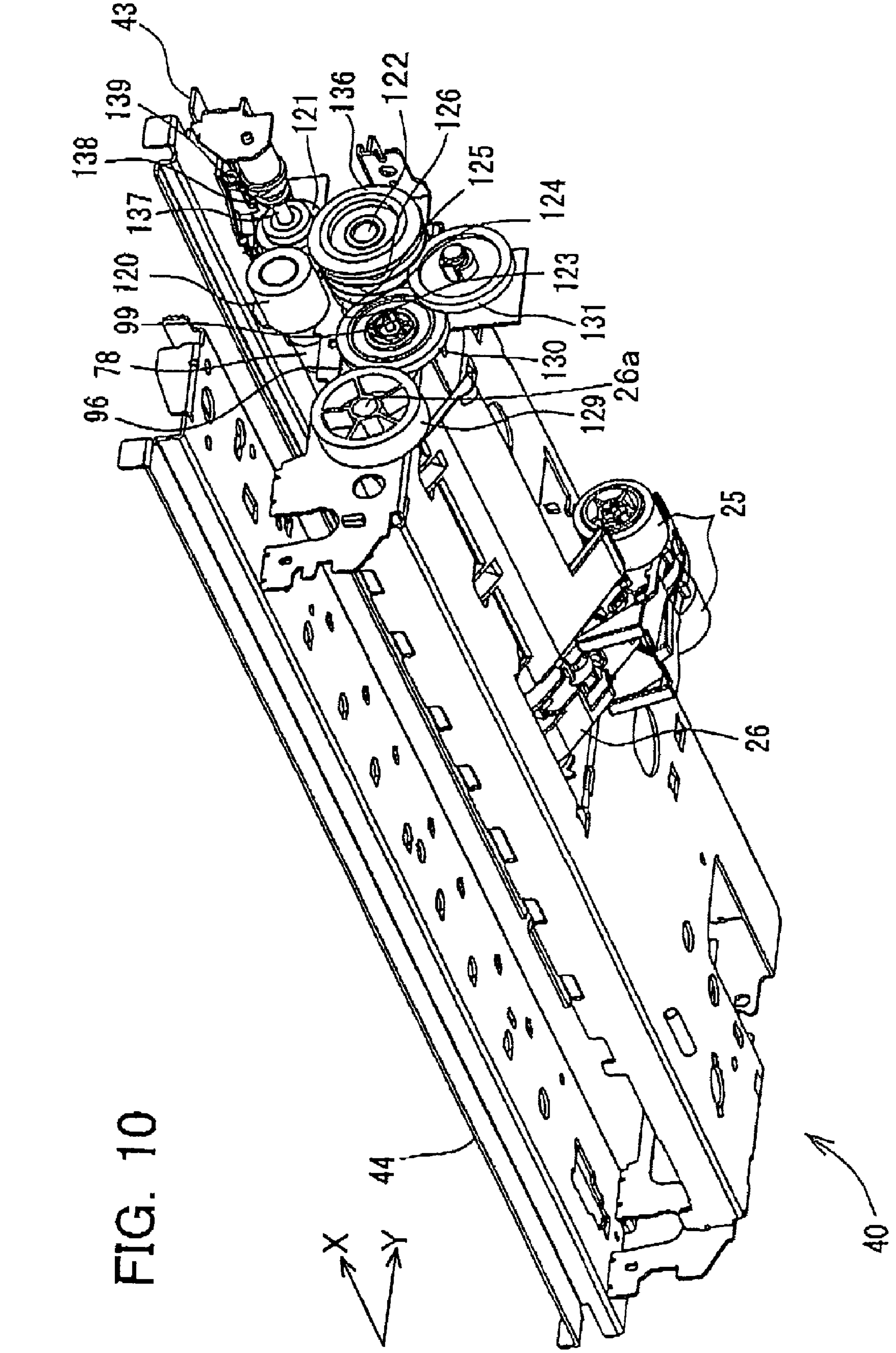

43
139
138
121
136
122
126
125
124
137
120
123
99
131
78
130
96
26a
129
25
26
44
40
X
Y

FIG. 10

FIG. 11

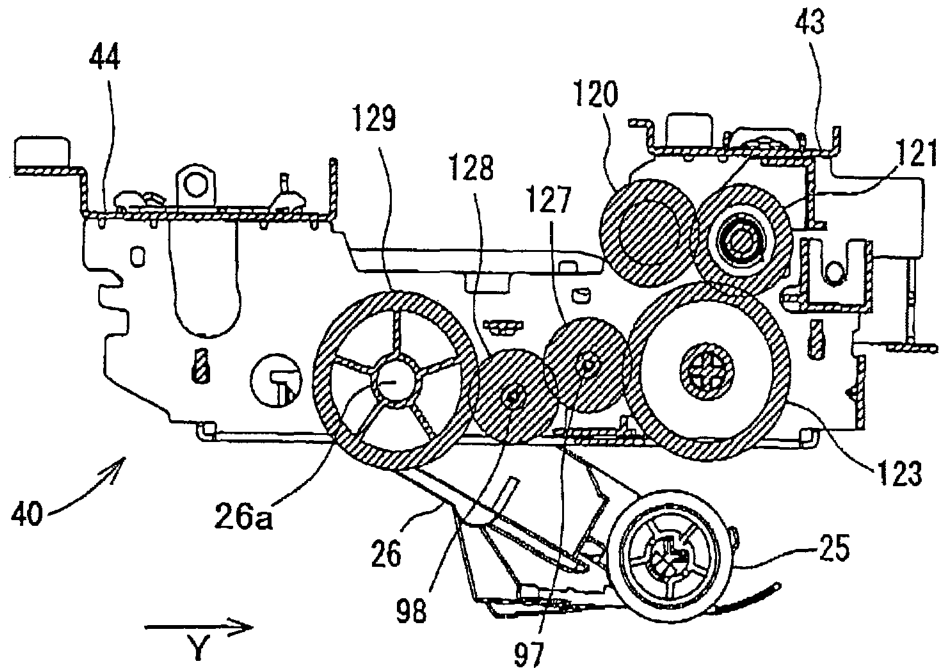

44
43
129
120
121
128
127
40
26a
123
26
25
98
97
Y

FIG. 12

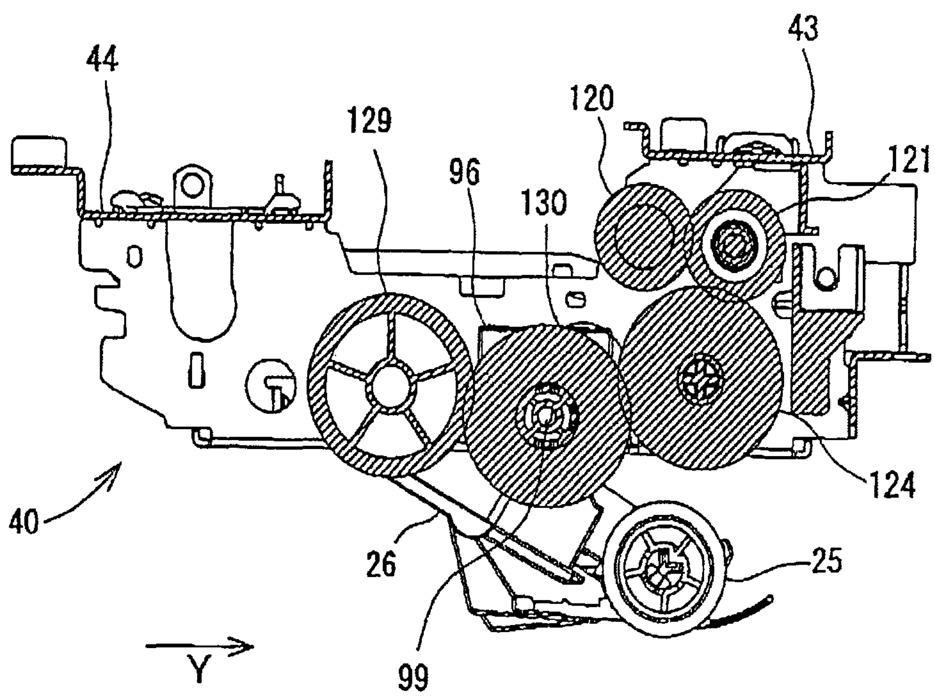
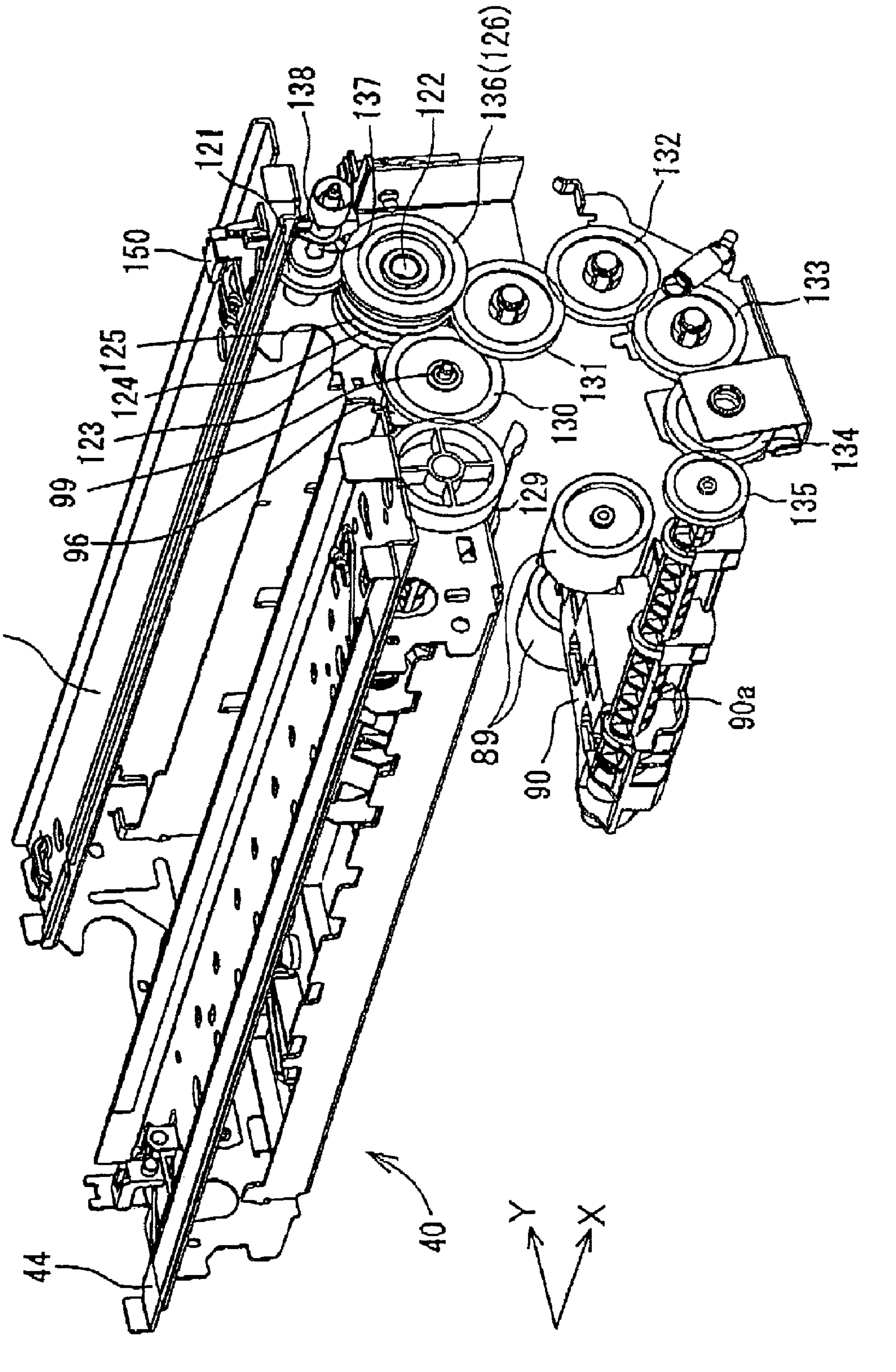

44
43
129
120
121
96
130
40
124
26
25
99
Y

FIG. 13



138
137
122
136(126)
121
150
132
133
125
124
123
131
130
134
99
96
129
135
43
89
90
90a
40
44
Y
X

FIG. 14

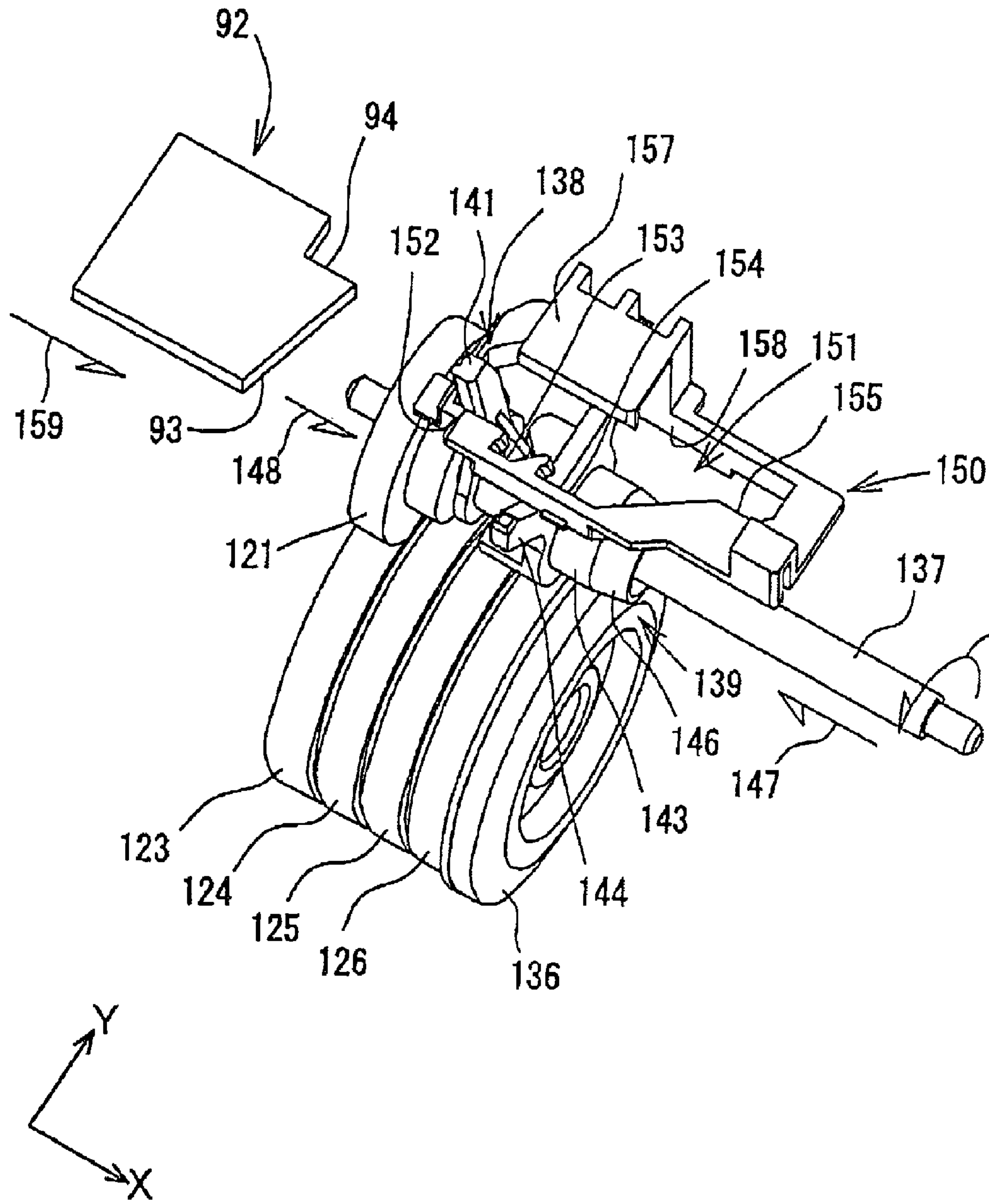

92
94
157
138
141
153
152
154
158
151
155
159
93
148
150
121
137
149
139
146
147
143
123
124
125
126
136
144
Y
X

FIG. 15

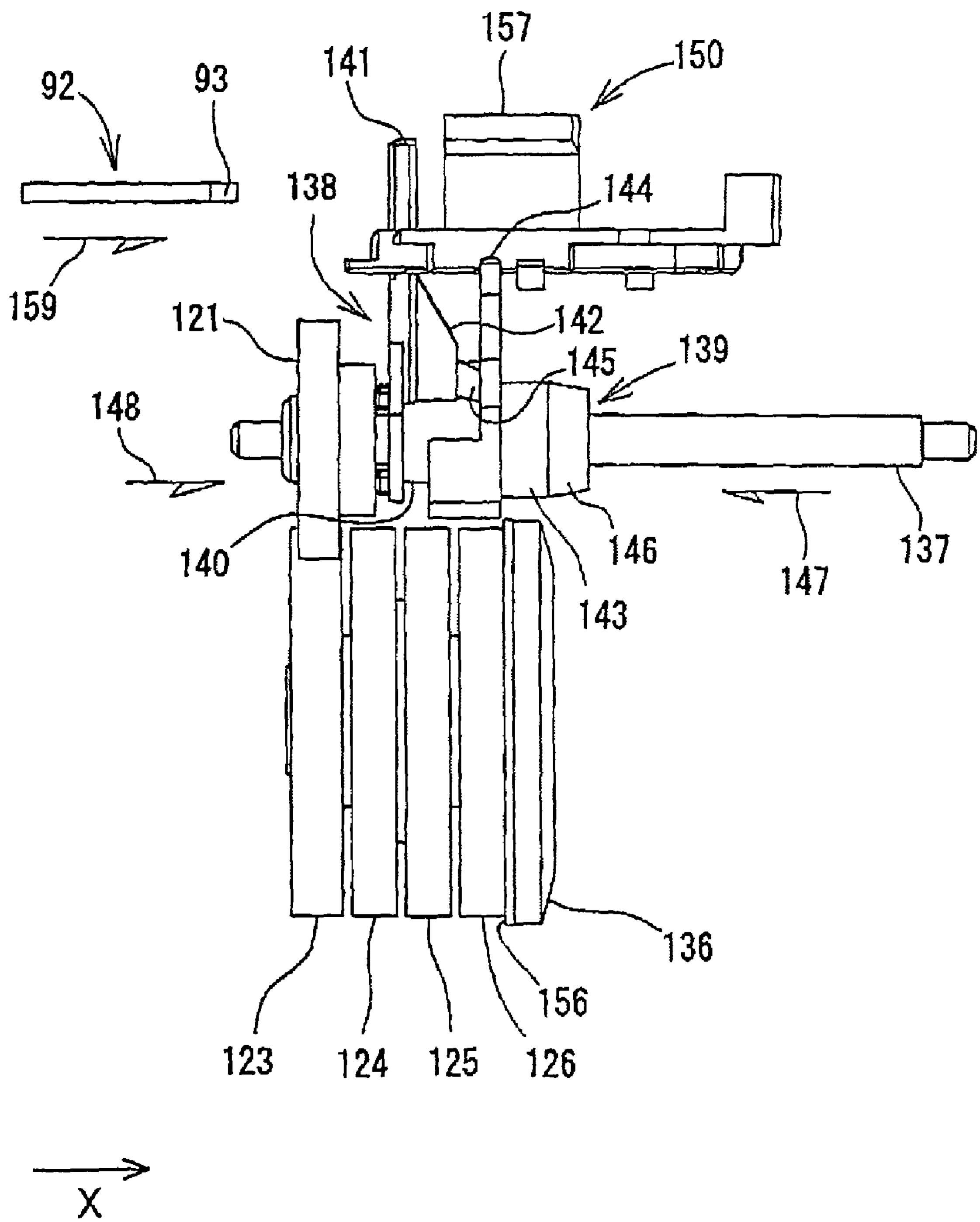

157
150
141
92
93
138
144
159
121
142
145
139
148
140
146
137
147
143
136
156
123
124
125
126
X

FIG. 16

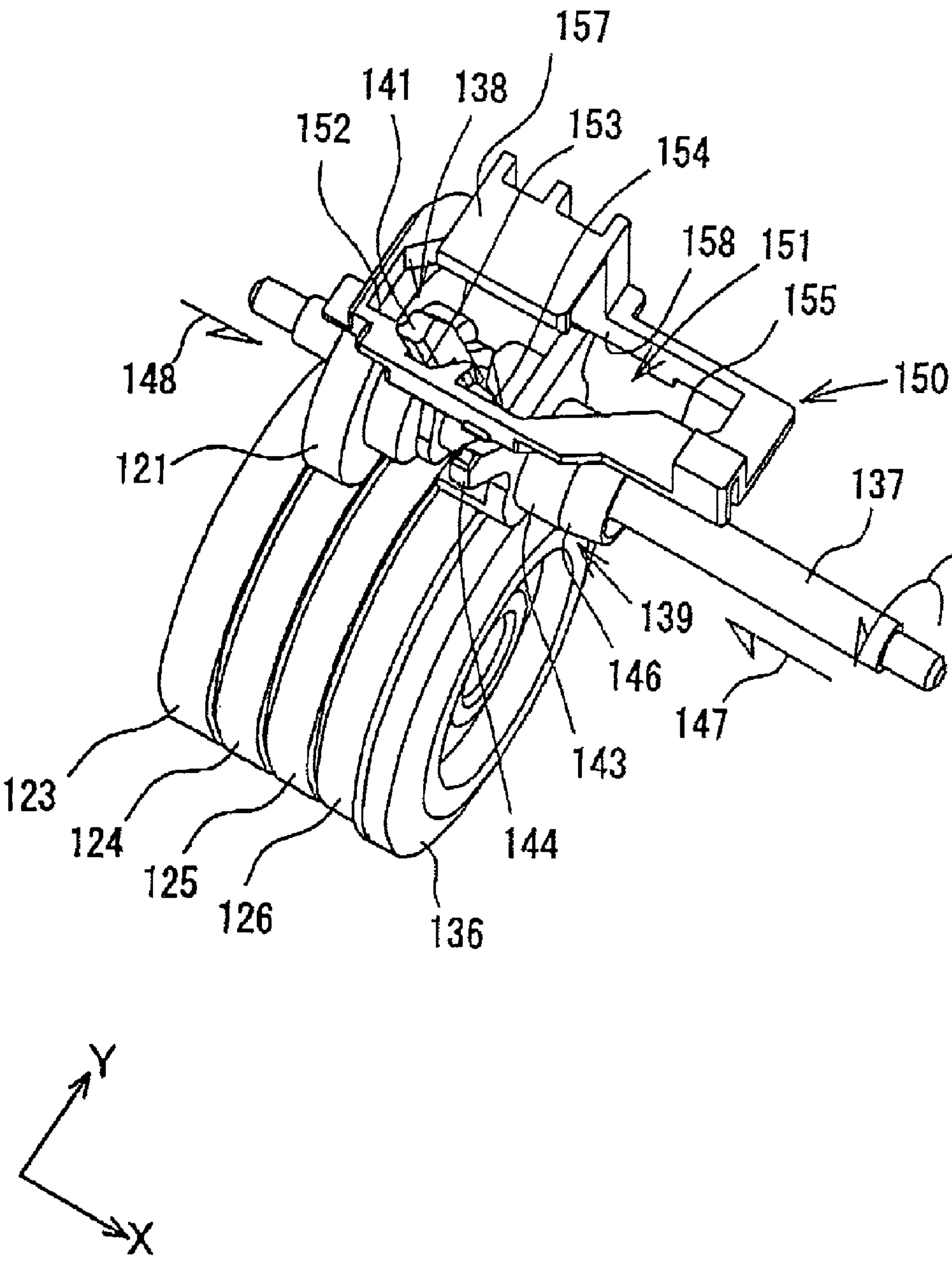

157
141
138
152
153
154
158
151
155
148
150
121
137
149
139
146
147
143
123
124
125
126
136
144
Y
X

FIG. 17

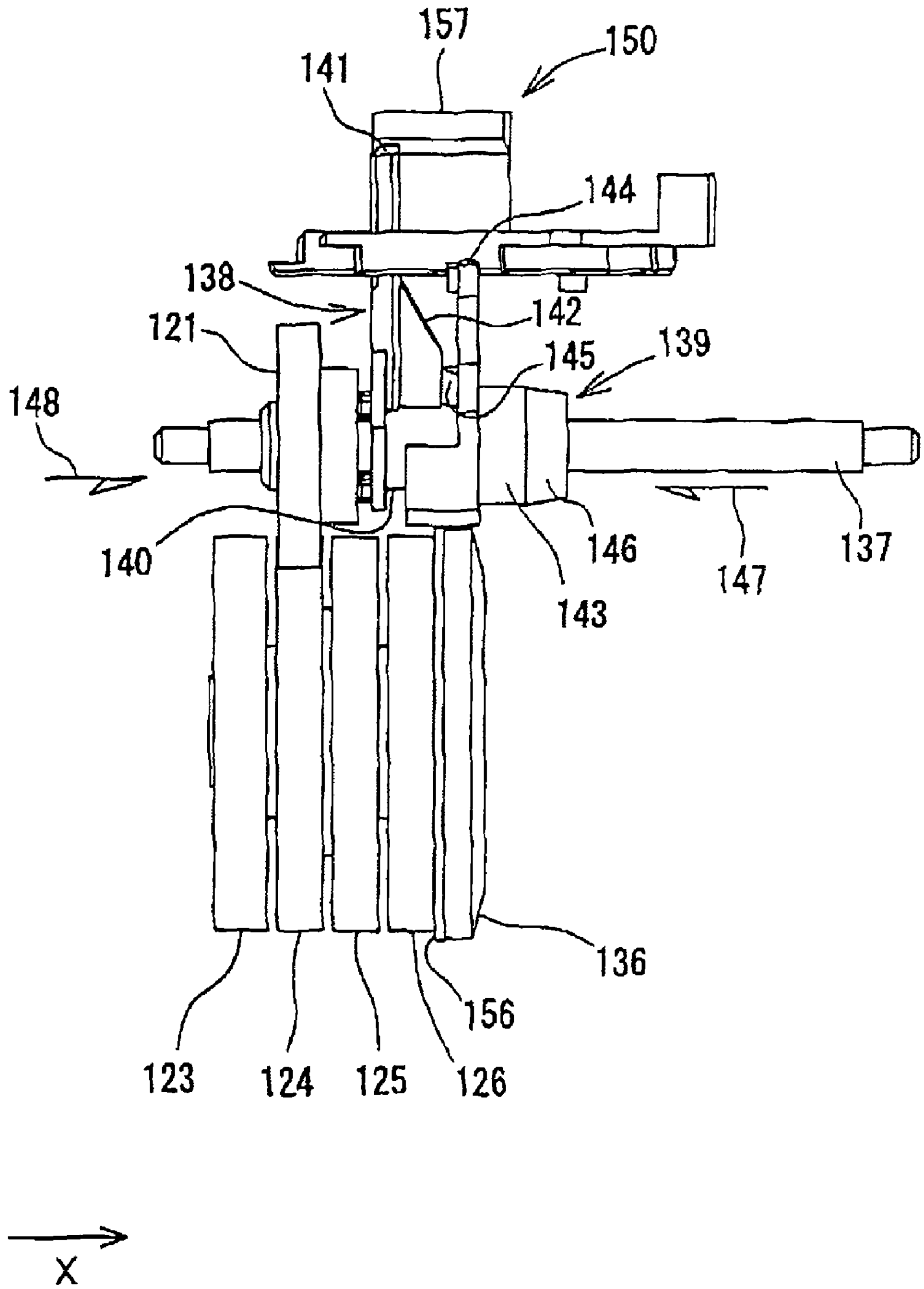

157
150
141
144
138
142
121
145
139
148
140
146
147
137
143
136
156
123
124
125
126
X

FIG. 18

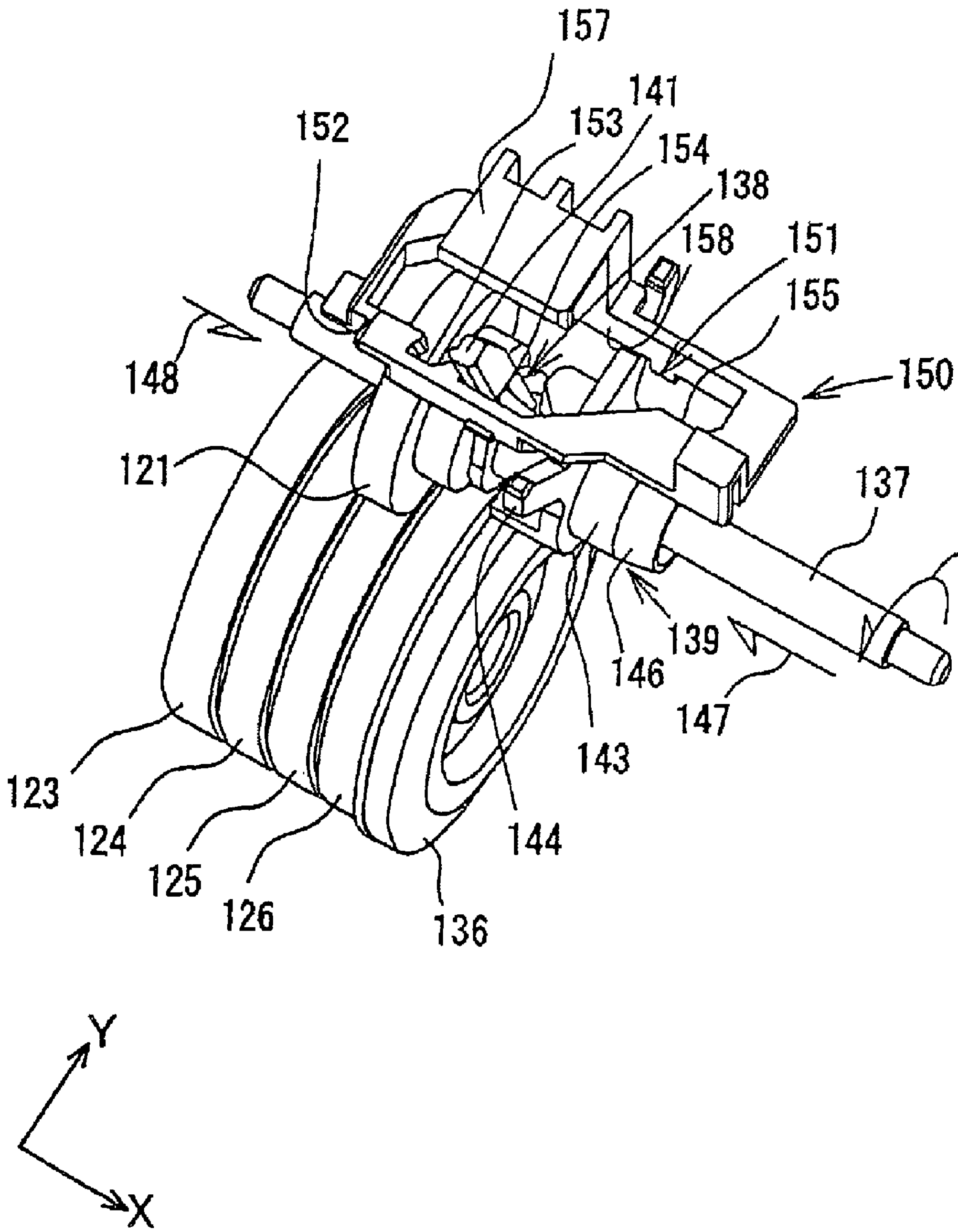

157
153
141
154
138
152
158
151
155
148
150
121
137
149
139
146
147
143
123
124
125
126
144
136
Y
X

FIG. 19

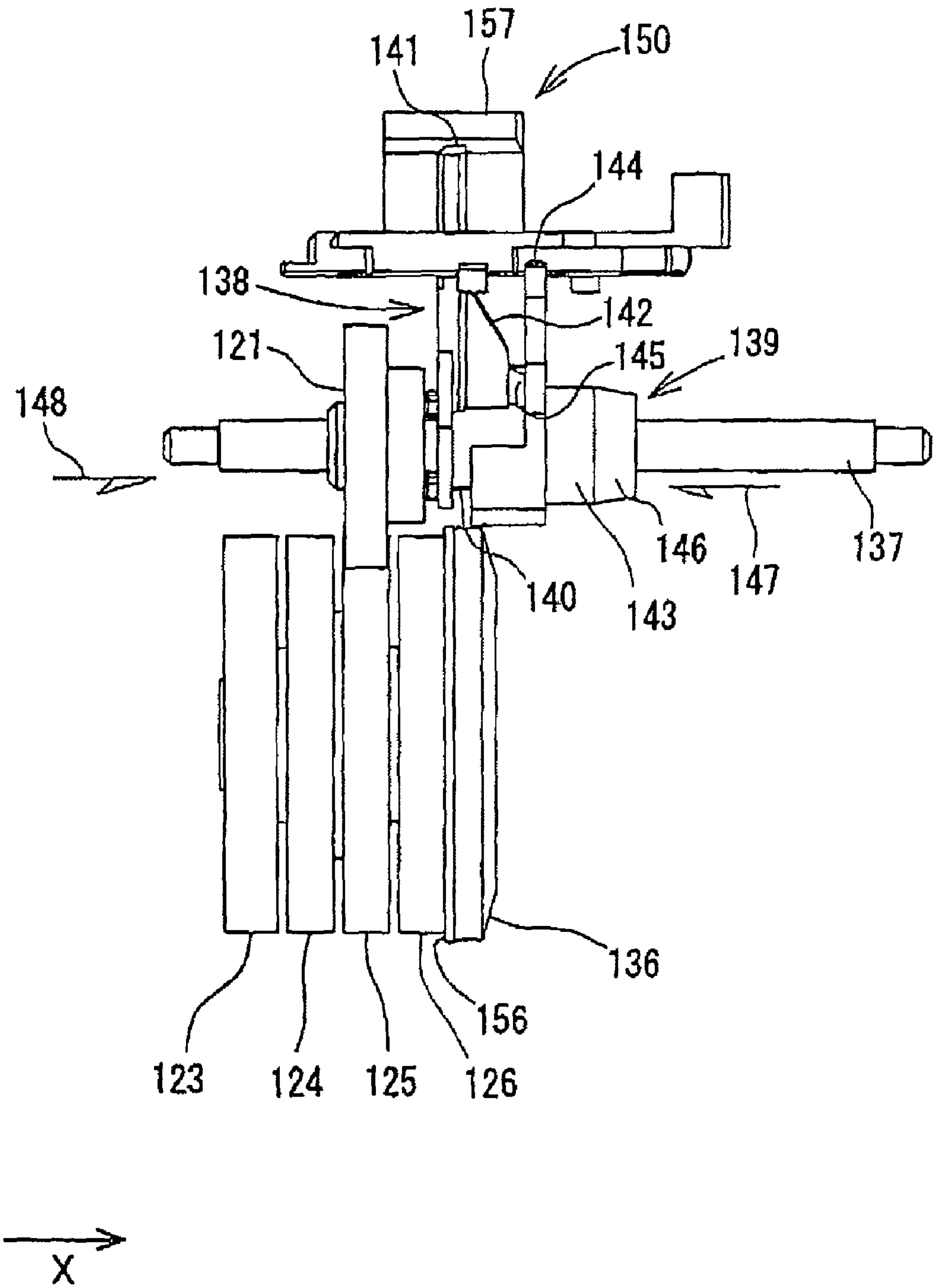

157
141
150
144
138
142
121
145
139
148
146
147
137
140
143
136
156
123
124
125
126
X

FIG. 20

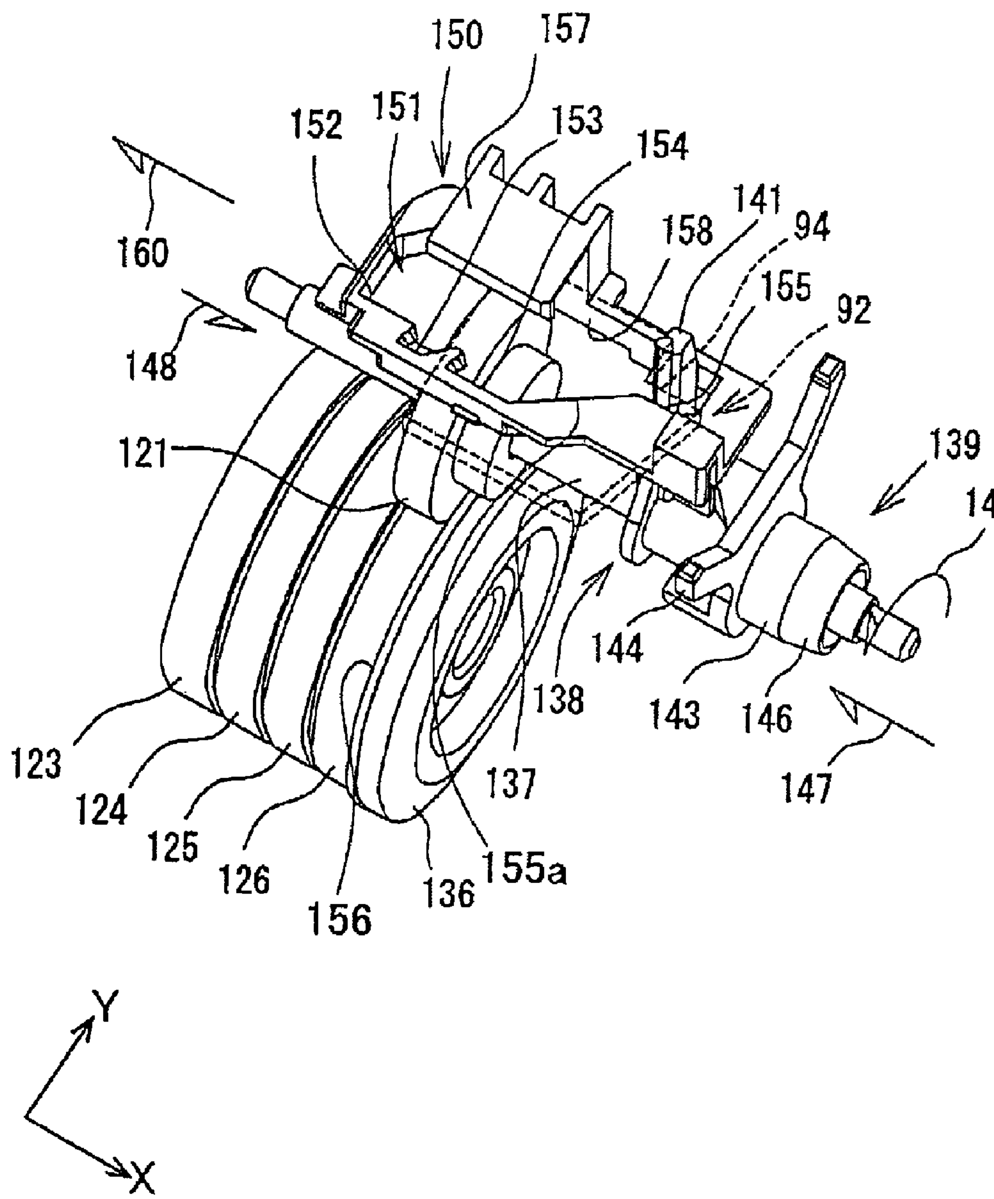

150
157
152
151
153
154
160
158
141
94
155
148
92
121
139
149
144
138
143
146
123
124
125
126
156
136
155a
137
147
Y
X

FIG. 21

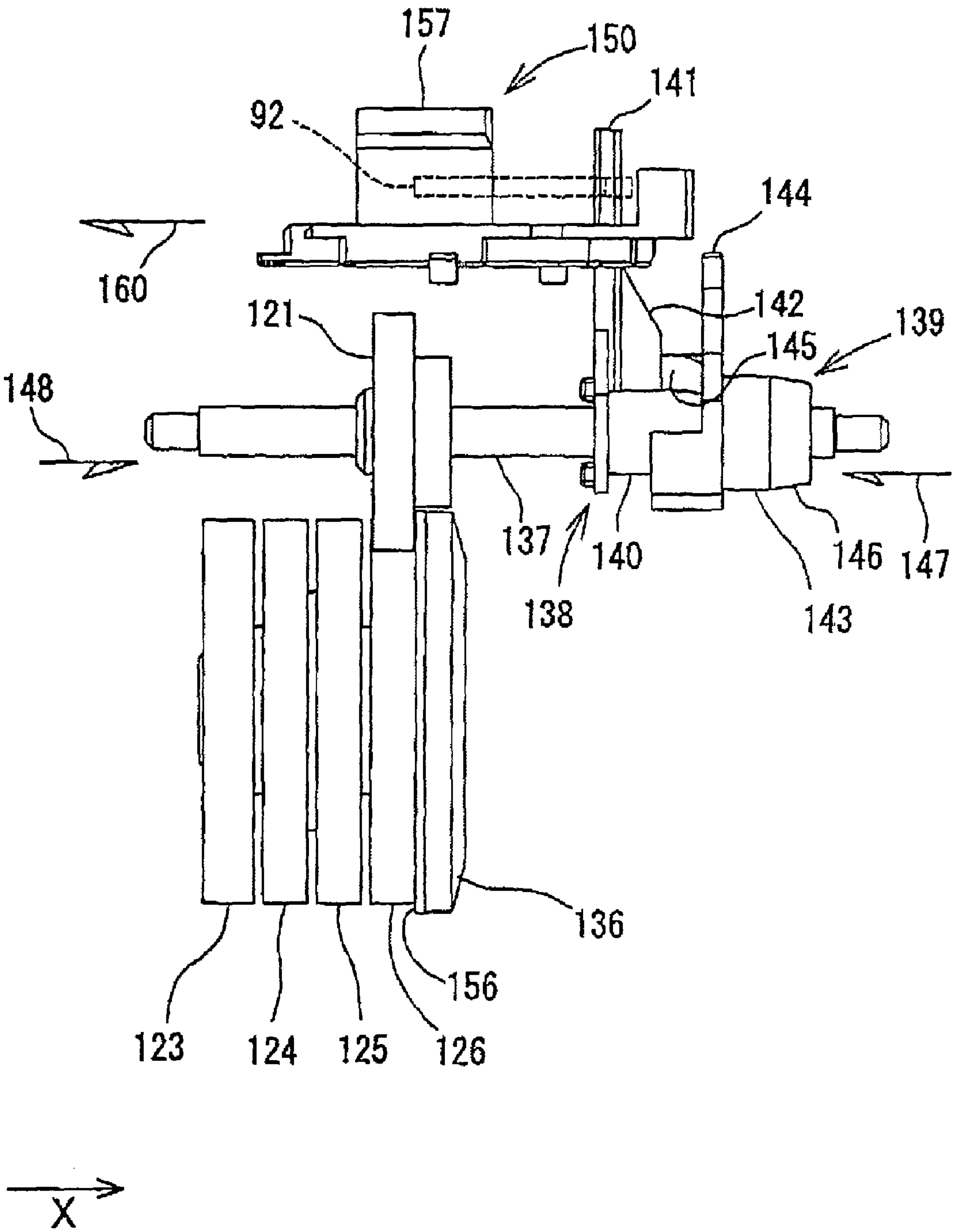

157
150
141
92
144
160
142
121
139
145
148
137
140
146
147
138
143
136
156
123
124
125
126
X

FIG. 22

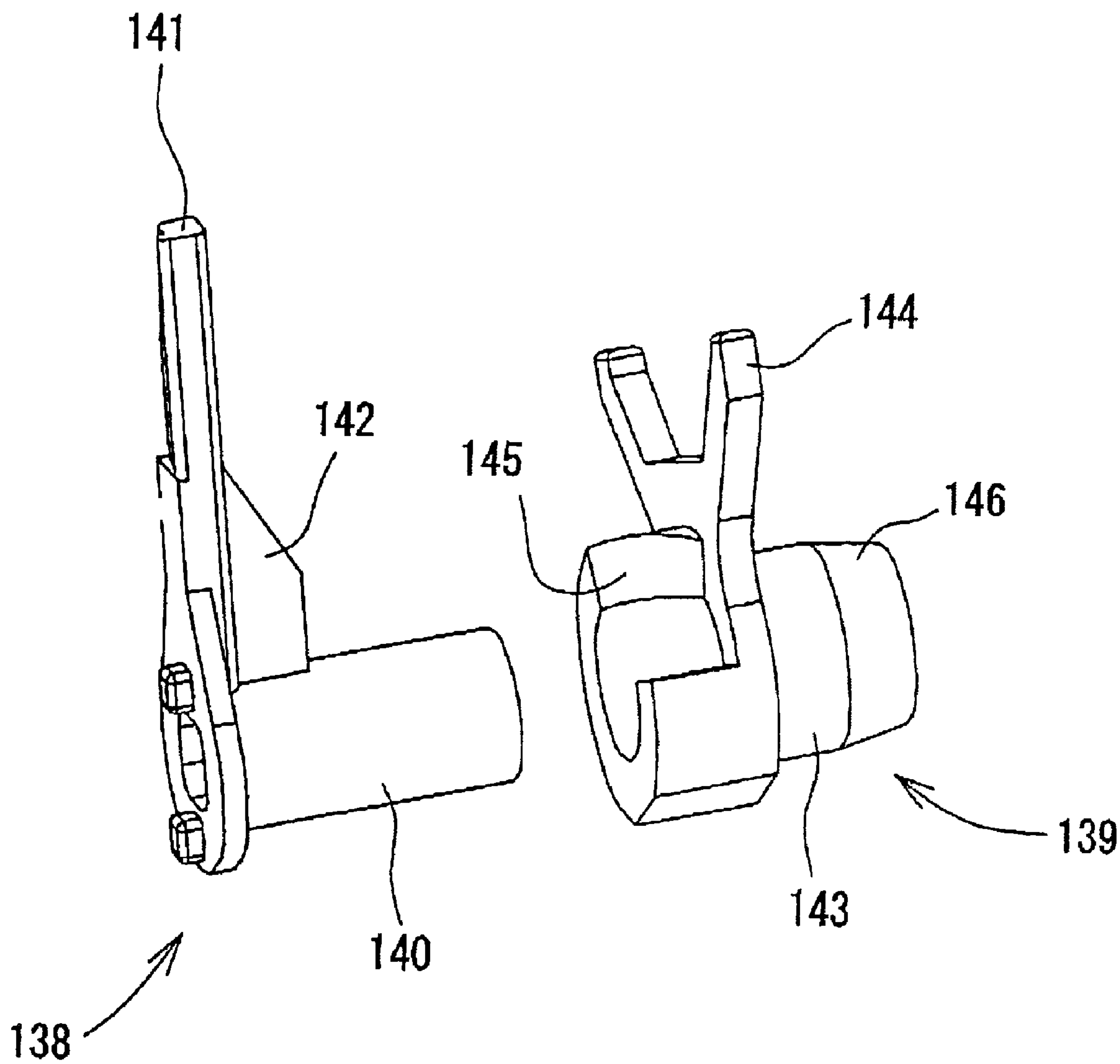


FIG. 23

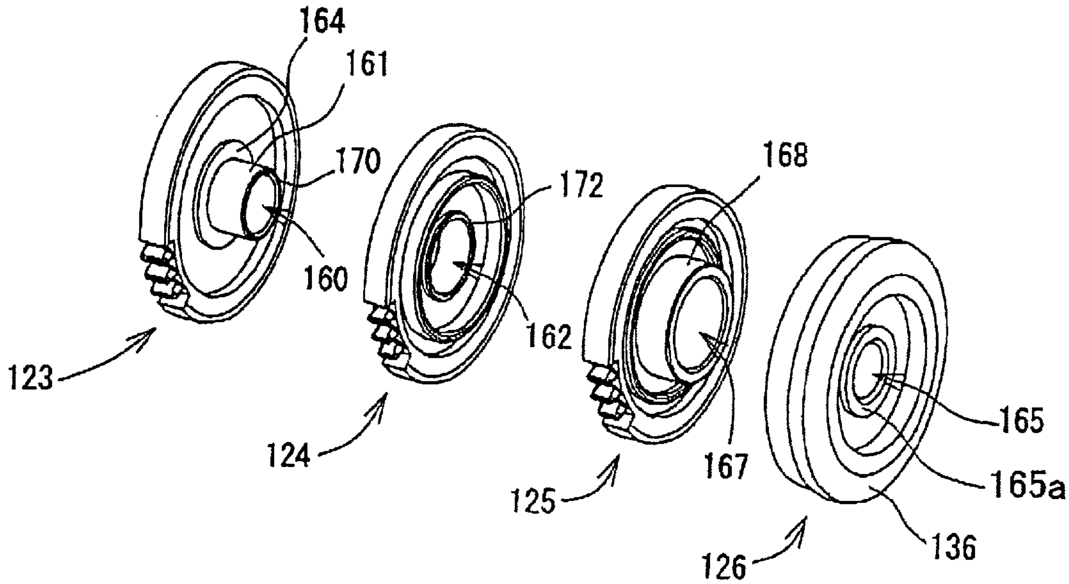

164
161
170
172
168
160
162
123
124
167
165
125
165a
126
136

FIG. 24

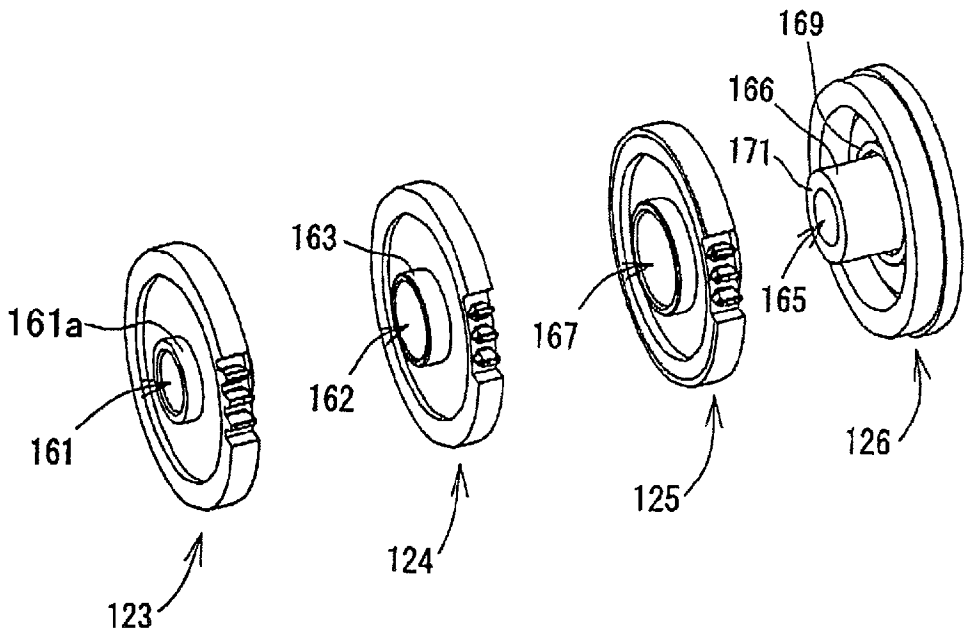

169
166
171
163
161a
167
165
162
161
126
125
124
123

FIG. 25

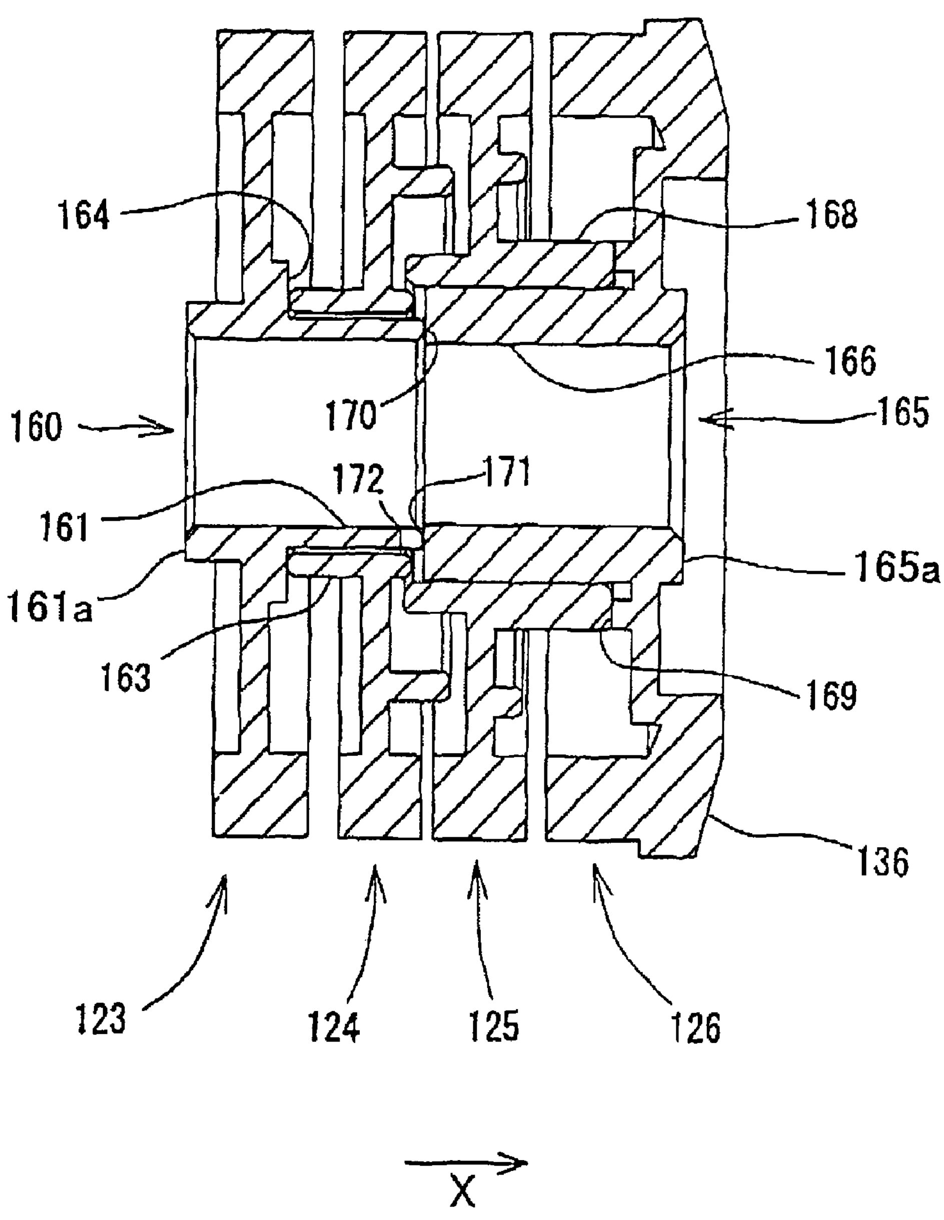

164
168
166
170
160
165
172
171
161
161a
165a
163
169
136
123
124
125
126
X

FIG. 26

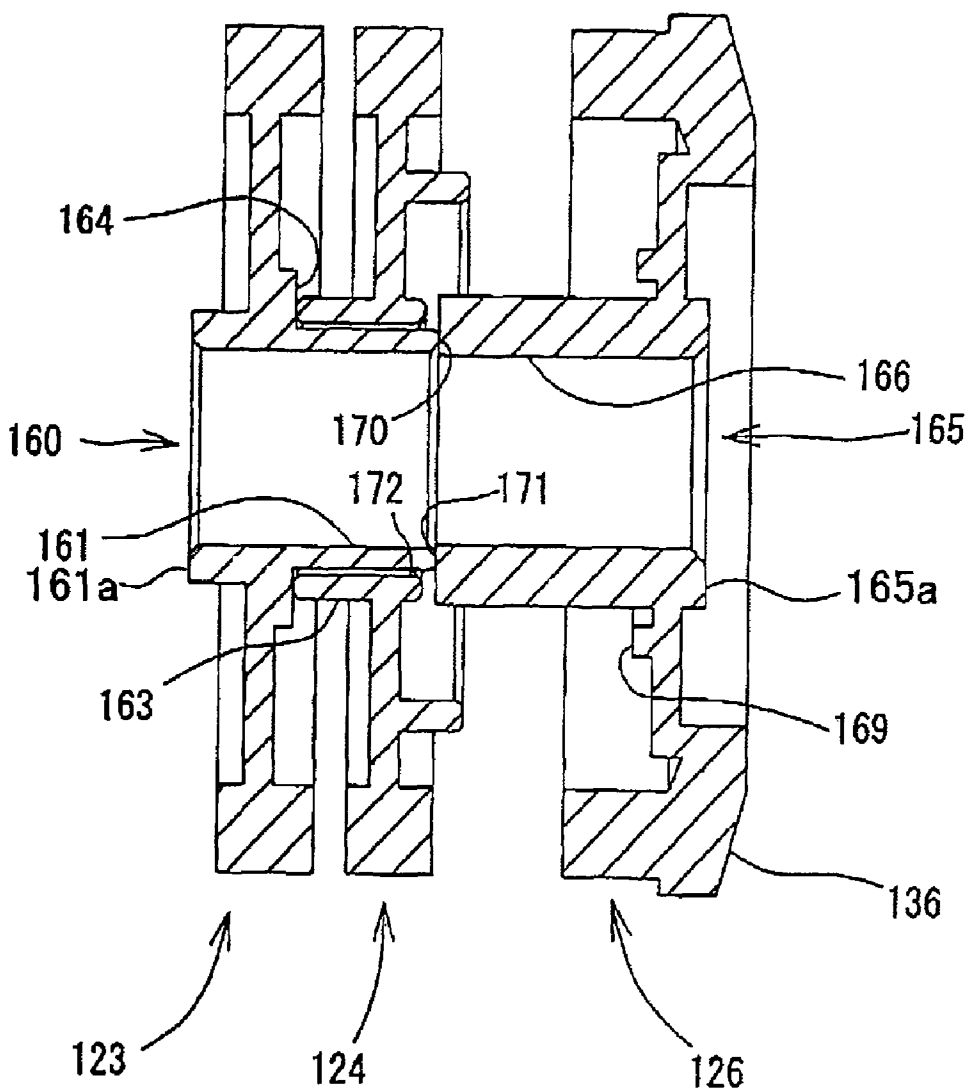

164
166
170
160
165
172
171
161
161a
165a
163
169
136
123
124
126

FIG. 27

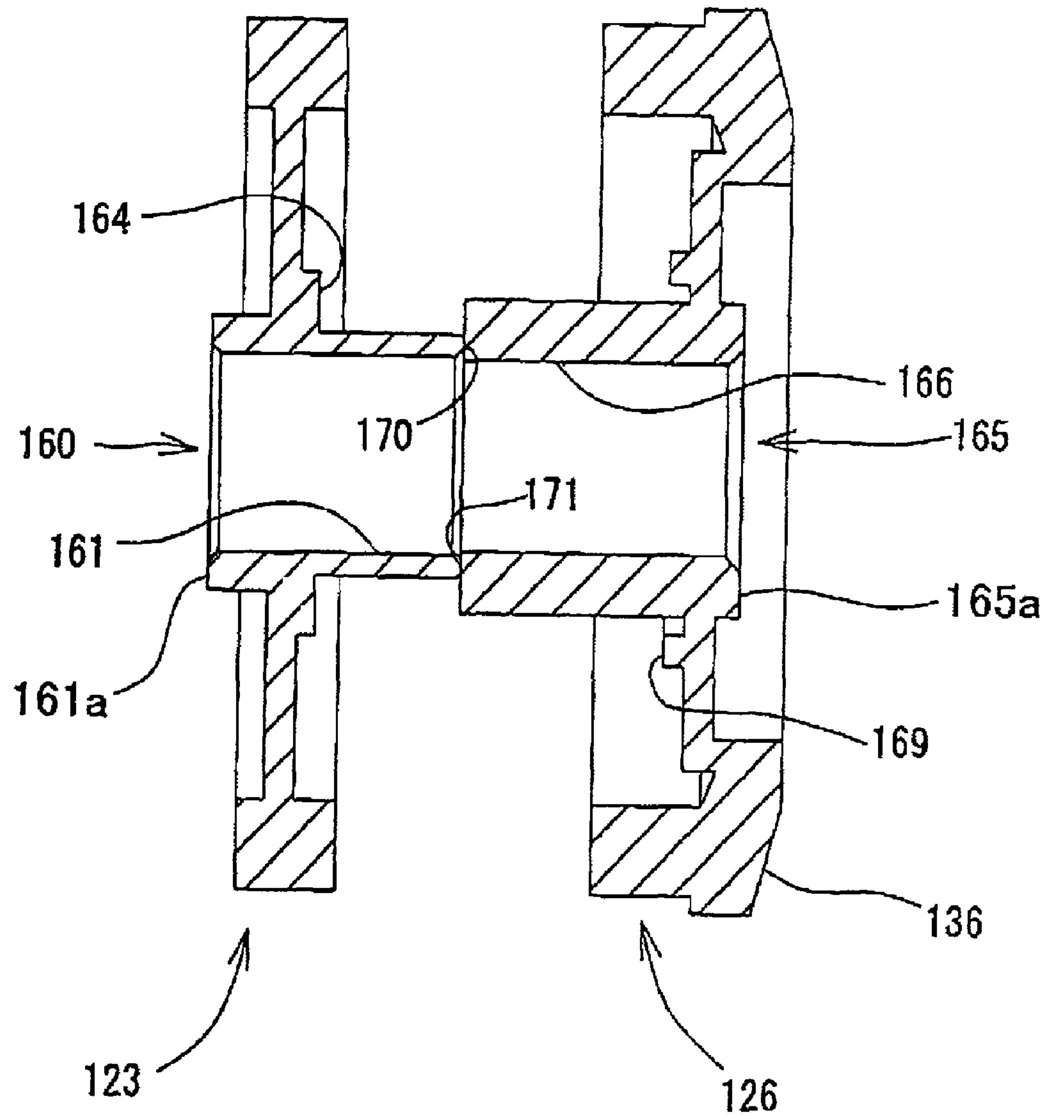


FIG. 28A

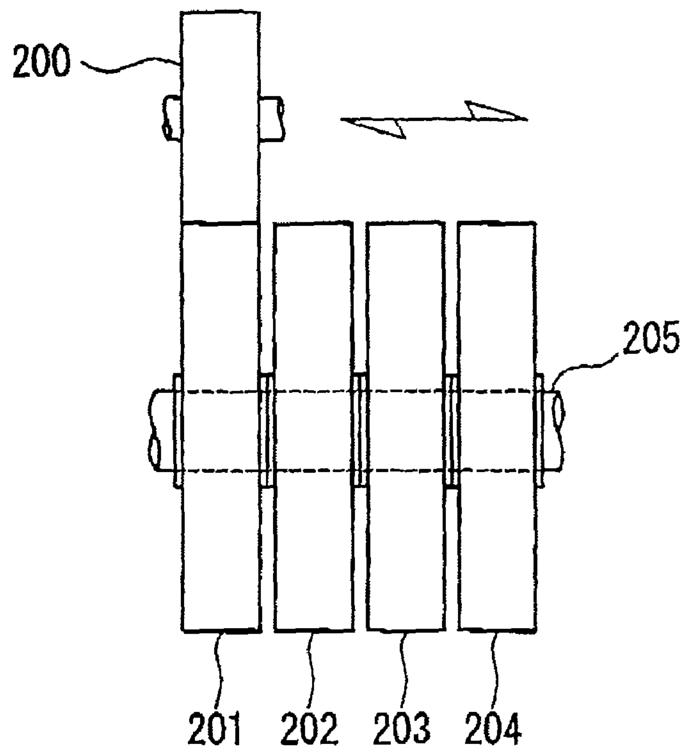
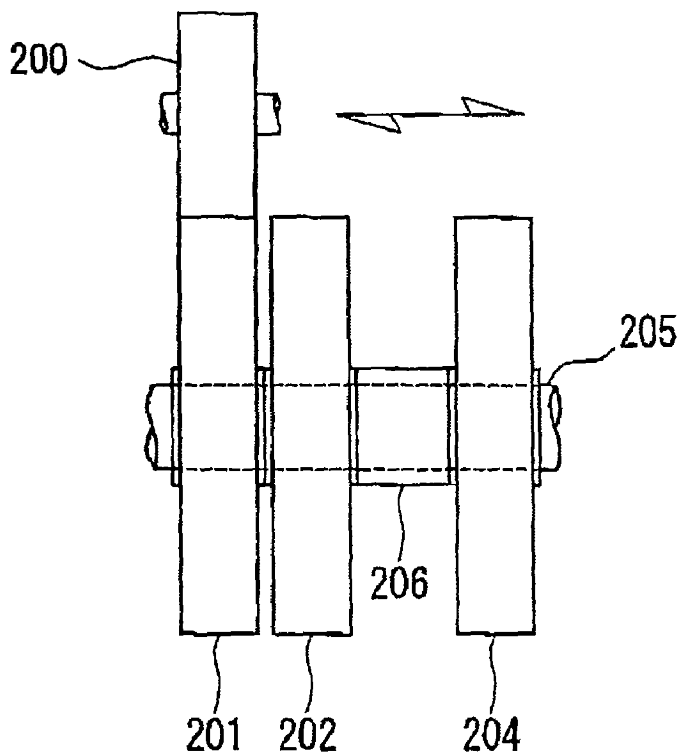


FIG. 28B



GEARS FOR MANUFACTURING PRINTER, METHOD OF USING THE GEARS, AND THE PRINTER

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to Japanese Patent Application No. 2005-380644 filed on Dec. 29, 2005, the contents of which are hereby incorporated by reference into the present application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to gears used for manufacturing, a printer, a method of using the gears, and the printer manufactured by using the gears.

2. Description of the Related Art

Printers which are capable of printing an image on a sheet on the basis of an input signal are generally known. These printers have a print head, a feeding tray for storing a plurality of sheets, a feeding roller, a conveying roller, a catch tray, and the like. The feeding tray can store a plurality of sheet of various sizes (for example, A4 size, B5 size, legal size, postcard size, and the like). When printing an image on a sheet, the feeding roller contacts with the sheets on the feeding tray **1** and then rotates. Accordingly, one sheet is taken out from the feeding tray. The sheet sent out by the feeding roller is conveyed by the conveying roller. An image is printed on the sheet by the print head while the sheet is conveyed. The sheet printed with the image is discharged to the catch tray by the conveying roller.

The printer comprises a plurality of mechanisms. For example, one mechanism rotates the feeding roller, and other mechanism rotates the conveying roller.

There are many printers that use a single motor to drive a plurality of mechanisms. This type of printer comprises a driving force transmitting device for transmitting driving force to the plurality of the motor. The driving force transmitting device is positioned between the mechanisms and the motor. A driving device is constituted by combining a plurality of gears.

There are cases in which the plurality of mechanisms, which are driven by a single motor, need to be driven independently. For example, sometimes switching needs to be performed between a state in which the conveying roller is rotated without rotating the feeding roller, and a state in which the feeding roller is rotated without rotating the conveying roller.

In order to respond to the above requirements, the driving force transmitting device sometimes comprises a switch gear and a set of driven gears. The switch gear is driven by the motor. Each of the driven gears is engaged with a corresponding mechanism. The switch gear can slide in a direction parallel to the axis of rotation of the switch gear (in other words, the switch gear can move in parallel). The set of driven gears is situated so it has a positional relationship where all of the gears can be engaged with the switch gear.

As the switch gear slides and then stops, it selects a driven gear allows it to be engaged. As the motor rotates in such a state, one selected driven gear rotates, and thereby the one mechanism in engagement with the driven gear is driven. By using the switch gear and the set of driven gears, an arbitrary mechanism can be driven independently from the other mechanisms by a single motor.

For example, FIG. **28**A shows a switch gear **200** and a set of driven gears **201** through **204**. These gears configure the driving force transmitting device of an inkjet printer for the required set of functions. This inkjet printer has a first feeding tray and a second feeding tray. Moreover, this inkjet printer can execute normal printing and high-speed printing on sheets stored in the first feeding tray. Furthermore, this inkjet printer can perform maintenance on the inkjet head.

The switch gear **200** can slide in a direction shown by an arrow in FIG. **28**A. The switch gear **200** is rotated by a driving force from a motor which is not shown. The driven gears **201** through **204** are planed rotatably around a rotation axis **205**. The driven gears **201** through **204** can be driven independently. The driven gear **201** is engaged with the first mechanism, which rotates a feeding roller of the first feeding tray (referred to as "first feeding roller" hereinafter) intermittently, so as to send sheets intermittently from the first feeding tray. The driven gear **202** is engaged with the second mechanism, which rotates the first feeding roller continuously, so as to send the sheets continuously from the first feeding tray. The driven gear **203** is engaged with the third mechanism that rotates a feeding roller sending sheets from the second feeding tray (refined to as "second feeding roller" hereinafter). The driven gear **204** is engaged with the fourth mechanism that transmits driving force to a maintenance device.

The switch gear **200** can slide and thereby engage with any of the driven gears **201** through **204**. When the driven gear is rotated by the switch gear **200**, the mechanism of engagement with the driven gear is activated. The mechanism to be activated is changed by sliding the switch gear **200**.

When normal printing is executed on sheets stored in the first feeding tray, the switch gear **200** is slid to a position for engagement with the driven gear **201**. Consequently, the driving force from the motor is transmitted to the first feeding roller by the first mechanism. The first mechanism intermittently rotates the first feeding roller so as to send the sheets intermittently. Therefore, the sheets are sent intermittently from the first feeding tray. Specifically, after printing on the first sheet is finished, a subsequent sheet is sent from the first feeding tray. In the normal printing, an image can be printed on a sheet with a high degree of accuracy.

When high-speed printing is executed on sheets stored in the first feeding tray, the switch gear **200** is slid to a position for engagement with the driven gear **202**. Consequently, the driving force from the motor is transmitted to the first feeding roller by the second mechanism. The second mechanism continuously rotates the first feeding roller so as to send the sheets continuously. Therefore, the sheets are sent continuously from the first feeding tray. Specifically, once the first sheet is sent from the first feeding tray, a subsequent sheet is sent from the first feeding tray. In the high-speed printing, an image can be printed on a number of sheets in a short amount of time.

The second feeding tray can store sheets that differ in size from the sheets stored in the first feeding tray. For example sheets of A4 size are stored in the first feeding tray, and sheets of B5 size are stored in the second feeding tray. A user can select the size of sheets and print an image on a sheet of the selected size.

When printing on the sheets stored in the second feeding tray, the switch gear **200** is slid to a position for engagement with the driven gear **203**. Consequently, the driving force from the motor is transmitted to the second feeding roller by the third mechanism. Accordingly, the second feeding roller is rotated, and thereby a sheet is sent from the second feeding tray.

In the inkjet printer, ink droplets are ejected from the inkjet head, whereby an image is printed on a sheet. Specifically, an actuator (an actuator using a modification of piezoelectric element or electrostrictive element, an actuator that locally heats ink by means of a heater element, or other actuator) of the inkjet head is activated, and the ink droplets are ejected from a nozzle onto a sheet. In the inkjet printer, occasionally bubbles are generated in the ink in the inkjet head, or foreign material is adhered to the nozzle. In such cases, the inkjet head cannot eject ink droplets in the preferred manner. Therefore, the inkjet printer needs to perform maintenance on the inkjet head. When performing maintenance, the bubbles, foreign material and the like are drawn and eliminated from the nozzle of the inkjet head. This operation is generally called the "purge operation". The purge operation is executed when, for example, the power of the inkjet printer is ON, or at predetermined time intervals. The maintenance device for performing the purge operation has a cap covering a nozzle surface of the inkjet head, and a pump for reducing the pressure inside the cap.

When executing the purge operation, the inkjet head is stopped at a position corresponding to the maintenance device. Then, the nozzle surface of the inkjet head is covered with the cap. At the same time, the switch gear **200** is slid to a position for engagement with the driven gear **204**. Consequently, the driving force from the motor is transmitted to the maintenance device by the fourth mechanism. Then, the pump of the maintenance device and the valve for switching the discharge destination of the pump are activated. Accordingly, the pressure inside the cap is reduced. When the pressure inside the cap is reduced, the bubbles, foreign material and the like are drawn out and removed from the nozzle.

As described above, by moving the position of the switch gear **200**, the transmission destination of the driving force of the driving force transmitting device is changed.

BRIEF SUMMARY OF THE INVENTION

Normally, printers are manufactured and sold as a series ranging from a standard type to a highly-functional type. Therefore, even in the case of printers of the same series, functions thereof are different depending on the printer type. For example, a highly-functional type printer can execute normal printing, high-speed printing, and maintenance on the print head, and has the second feeding tray. However, a standard type printer does not have the second feeding tray. Also, there are types of printers that cannot execute high-speed printing.

Normally, common parts are used among the printer types of the same series. Therefore, when manufacturing a printer with a smaller number of functions, its driving force transmitting device is produced without the gears required for the omitted functions.

For example, FIG. **28**B shows a set of driven gears of a driving force transmitting device of an inkjet printer of the same series but different type from the inkjet printer shown in FIG. **28**A. This printer does not have the second feeding tray. Therefore, the set of driven gears shown in FIG. **28**B are constructed without the driven gear **203** (the gear for transmitting the driving force to the second feeding roller) which is found in the set of driven gears shown in FIG. **28**A.

As described above, a printer with a smaller number of functions has a smaller number of driven gears. This is because when a function is not necessary the driven gear required for that function is removed. However, if one driven gear is removed, the positions of other driven gears placed on the same axis (the positions in a direction parallel to the rotation axis) cannot be fixed. Therefore, when a printer has a smaller number of functions, a spacer needs to be placed in place of the unnecessary driven gear.

For example, in the inkjet printer shown in FIG. **28**B, a spacer **206** is placed in place of the driven gear **203**. By placing the spacer **206**, the positions of the driven gears **201**, **202**, and **204** are fixed.

As described above, in conventional printers, a spacer had to be placed in place of an unnecessary driven gear when manufacturing a printer with a smaller number of functions. Therefore, this creates a problem, as the number of parts attached to the rotation axis of the driven gears can not be reduced even when the printer has a smaller number of functions.

The present invention provides a printer, which can use the same driven gears as other types of printer, however it does not require spacers even if the number of driven gears is reduced.

The present invention provides a pair of driven gears and a set of driven gears, which can be shared by a plurality of types of printers and do not have to be replaced with a spacer even if the number of driven gears is reduced.

The present invention provides a method of using the pair of driven gears for manufacturing a plurality of types of printers.

A printer according to the present invention comprises a switch gear, a first driven gear and a second driven gear. The switch gear has a spur gear and is able to slide along a direction that is parallel to a rotation axis of the spur gear. The first driven gear has a first spur gear and a cylinder fixed to the first spur gear. The cylinder is concentric with respect to the first spur gear and extends along the above direction. The second driven gear has a second spur gear with a hole that is concentric with respect to the second spur gear. The hole extends along the above direction. The second driven gear is mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear. The second driven gear is able to rotate with respect to the first driven gear. The switch gear slides along the above direction between a fist position for engagement with the first driven gear and a second position for engagement with the second driven gear.

In this printer, the cylinder of the first driven gear is concentric with respect to the rotation axis of the first spur gear. Also, the hole of the second driven gear is concentric with respect to the rotation axis of the second spur gear. By inserting the cylinder of the first driven gear into the hole of the second driven gear, the second driven gear is placed so as to be able to rotate with respect to the first driven gear. Therefore, the first driven gear and the second driven gear can rotate around the same rotation axis. Therefore, the switch gear can slide between the first position for engagement with the first driven gear and the second position for engagement with the second driven gear.

Moreover, the second driven gear is placed on the cylinder of the first driven gear. Therefore, even if the second driven gear is not placed, the position of the first driven gear in the abovementioned direction is not changed compared to the case where the second driven gear is placed. Specifically, the position of the first driven gear in the abovementioned direction is not changed by the presence and absence of the second driven gear. Therefore, it is not necessary to place a space in place of the second driven gear when the second driven gear is unnecessary.

The present invention also describes a pair of driven gears commonly used for manufacturing a first type of printer having a first mechanism and a second type of printer having the first and a second mechanism. The first driven gear is for engagement with the first mechanism. The second driven gear is for engagement with the second mechanism. The first driven gear has a first spur gear and a cylinder fixed to the first spur gear. The cylinder is concentric with respect to the first spur gear and extends along a direction that is parallel to the rotation axis of the first spur gear. The second driven gear has a second spur gear with a hole that is concentric with respect to the second spur gear. The hole extends along a direction that is parallel to the rotation axis of the second spur gear.

Only the first driven gear is used for manufacturing the first type of printer, and the first and second driven gears are used for manufacturing the second type of printer. In this case, the first and second driven gears are arranged such that the cylinder of the first driven gear is inserted into the hole of the second driven gear.

The pair of gears are placed inside the printer when manufacturing the printer. Only the first driven gear is used when manufacturing the first type of printer. Both the first driven gear and the second driven gear are used when manufacturing the second type of printer. In this case, the first driven gear and second driven gear are used in a stare in which the cylinder of the first driven gear is inserted into the hole of the second driven gear. Therefore, the first driven gear and the second driven gear can rotate around the same rotation axis. Further, since the second driven gear is placed on the cylinder of the first driven gear, the position of the first driven gear in the direction parallel to the rotation axis of the first spur gear is not changed by the presence and absence of the second driven gear. Therefore, it is not necessary to place a spacer in place of the second driven gear when, manufacturing the first type of printer.

The present invention also describes a set of driven gears commonly used for manufacturing a first type of printer having a first and a fourth mechanism, a second type of printer having the first, a second and the fourth mechanism, and a third type of printer having the first, the second, a third and the fourth mechanism. The first driven gear is for engagement with the first mechanism. The second driven gear is for engagement with the second mechanism. The third driven gear is for engagement with the third mechanism. The fourth driven gear is for engagement with the fourth mechanism. The first driven gear has a first spur gear and a cylinder fixed to the first spur gear. The cylinder of the first driven gear is concentric with respect to the first spur gear and extends along a direction that is parallel to the rotation axis of the first spur gear. The second driven gear has a second spur gear with a hole that is concentric with respect to the second spur gear. The hole of the second driven gear extends along a direction that is parallel to the rotation axis of the second spur gear. The third driven gear has a third spur gear with a hole that is concentric with respect to the third spur gear. The hole of the third driven gear extends along a direction that is parallel to the rotation axis of the third spur gear. The fourth driven gear has a fourth spur gear and a cylinder fixed to the fourth spur gear. The cylinder of the fourth driven gear is concentric with respect to the fourth spur gear and extends along a direction that is parallel to the rotation axis of the fourth spur gear.

Only the first and fourth driven gears are used for manufacturing the first type of printer. The first, second and fourth driven gears are used for manufacturing the second type of printer. The first, second, third and fourth driven gears are used for manufacturing the third type of printer.

In any case, the first and fourth driven gears are arranged such that the distal end of the cylinder of the first driven gear is in contact with the distal end of the cylinder of the fourth driven gear. When the second driven gear is used, the second driven gear is arranged such that the cylinder of the first driven gear is inserted into the hole of the second driven gear. When the third driven gear is used, the third driven gear is arranged such that the cylinder of the fourth driven gear is inserted into the hole of the third driven gear.

The set of gears are placed inside the printer when manufacturing the printer.

The first and fourth driven gears are used when manufacturing the first type of printer. When manufacturing the first type of printer, the first and fourth driven gears are arranged such that the distal end of the cylinder of the first driven gear is in contact with the distal end of the cylinder of the fourth driven gear.

The second driven gear is used when manufacturing the second type of printer. The second driven gear is arranged such that the cylinder of the first driven gear is inserted into the hole of the second driven gear. Therefore, the positional relationship between the first driven gear and the fourth driven gear is not changed by the presence or absence of the second driven gear.

The third driven gear is used when manufacturing the third type of printer. The third driven gear is arranged such that the cylinder of the fourth driven gear is inserted into the hole of the third driven gear. Therefore, the positional relationship between the first driven gear and the fourth driven gear is not changed by the presence or absence of the third driven gear.

As described above, when the set of driven gears are used, the positional relationship between the first driven gear and the fourth driven gear is not changed by the presence or absence of the second driven gear and the third driven gear. Therefore, when manufacturing the first type and second type of printers, it is not necessary to place a spacer in place of the second driven gear and the third driven gear.

The present invention also describes a method of using at least one of the following gears for manufacturing a first type of printer and a second type of printer. The gears comprise:

(1) a first driven gear having a first spur gear and a cylinder fixed to the first spur gear, the cylinder being concentric with respect to the first spur gear and extending along a direction that is parallel to the rotation axis of the first spur gear,

(2) a second driven gear having a second spur gear with a hole that is concentric with respect to the second spur gear and extends along the direction.

The method comprises the steps of: mounting only the first driven gear within the first type of printer in order to manufacture the first type of printer, and mounting the first and second driven gears within the second type of printer in order to manufacture the second type of printer. In this case, the first and second driven gears are arranged such that the cylinder of the first driven gear is inserted into the hole of the second driven gear.

In the above method, only the first driven gear is used when manufacturing the first type of printer. Also, the first driven gear and the second driven gear are used when manufacturing the second type of printer. When manufacturing the second type of printer, the first and second driven gears are arranged such that the cylinder of the first driven gear is inserted into the hole of the second driven gear. In this manner, the second driven gear is placed in the cylinder of the first driven gear, thus the position of the first driven gear, which is in the direction parallel to the rotation axis of the first spur gear, is not changed by the presence or absence of the second driven gear. Therefore, when manufacturing the first type of printer, it is not necessary to place a spacer in place of the second driven gear.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing an exterior view of a complex machine of an embodiment of the present invention;

FIG. **2** is a schematic cross-sectional view showing an internal structure of the complex machine;

FIG. **3** is a plan view showing an internal structure of a printer;

FIG. **4** is a plan view of a purging device;

FIG. **5** is a cross-sectional view taken along the line V-V of FIG. **4**;

FIG. **6** is a cross-sectional view of the purging device in which a discharge cap is lifted up, the cross-sectional view being taken along the line V-V;

FIG. **7** is a plan view showing a bottom surface of an inkjet head;

FIG. **8** is a view showing a frame format of an enlarged cross section of a part of the inkjet head;

FIG. **9** is a block diagram showing the structure of a control section of the complex machine;

FIG. **10** is a perspective view of first and second mechanisms;

FIG. **11** is a view showing a frame format of the first mechanism;

FIG. **12** is a view showing a frame format of the second mechanism;

FIG. **13** is a perspective view of a third mechanism;

FIG. **14** is a perspective view showing a state in which a switch gear is in engagement with a first driven gear;

FIG. **15** is a front view showing the state in which the switch gear is in engagement with the first driven gear;

FIG. **16** is a perspective view showing a state in which the switch gear is in engagement with a second driven gear;

FIG. **17** is a front view showing the state in which the switch gear is in engagement with the second driven gear;

FIG. **18** is a perspective view showing a state in which the switch gear is in engagement with a third driven gear;

FIG. **19** is a front view showing the state in which the switch gear is in engagement with the third driven gear;

FIG. **20** is a perspective view showing a state in which the switch gear is in engagement with a fourth driven gear;

FIG. **21** is a front view showing the state in which the switch gear is in engagement with the fourth driven gear;

FIG. **22** is a perspective view of a lever member and a fixing member;

FIG. **23** is a perspective view showing a set of driven gears;

FIG. **24** is a perspective view showing the set of driven gears;

FIG. **25** is a cross-sectional view showing a setting structure of the set of driven gears of the complex machine;

FIG. **26** is a cross-sectional view showing a setting structure of the set of driven gears of a complex machine of an additional embodiment;

FIG. **27** is a cross-sectional view showing a setting structure of the set of driven gears of a complex machine of another additional embodiment; and

FIG. **28**A and FIG. **28**B are figures showing a setting structure of a set of driven gears of a conventional printer.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, embodiments of the present invention are described with reference to the drawings. Normally, there are a series of complex machines ranging from a general-purpose type machine, which has fewer functions, to an upper type machine, which has a number of functions. The functions of the complex machines vary according to the type of complex machine even if the complex machines are of the same series. A user selects an appropriate type for his intended purpose from the series of complex machines, and buys the selected type of machine. The complex machine **1** described hereinafter is a type of complex machine which has the largest number of functions in the series.

FIG. **1** is a figure showing an exterior view of the complex machine **1** of the present embodiment, and FIG. **2** is a schematic vertical cross-sectional view showing an internal structure of the complex machine **1**. As shown in FIG. **1**, the outer shape of the complex machine **1** is substantially a rectangular solid. The complex machine **1** has a scanner **3** in the upper section thereof, and a printer **2** in the lower section thereof. The complex machine **1** is a multi function device (MFD) which has a printer function, scanner function, copy function, and facsimile function. A control panel **5** is placed on the near side of the upper section of the complex machine **1**. An external computer, digital camera, or the like can be connected to the complex machine **1**. The complex machine **1** operates based on instructions inputted from the control panel **5** or the external computer. It should be noted that, hereinafter the direction from the left to the right of the complex machine **1** is referred to as the "X direction", and the direction from the near side to the back of the complex machine **1** is referred to as the "Y direction" (see FIG. **1**).

The control panel **5** for controlling the printer **2** and scanner **3** is placed in the front upper section of the complex machine **1**. The control panel **5** is constituted by various control buttons, a liquid crystal display screen, and the like. The control buttons include a button for turning the power ON and OFF, a start button for reading or printing an image, an operation stop button, a switch button for switching operation modes (the copy function, scanner function, facsimile function and the like), and a numerical keypad for performing various settings and inputting a fax number.

Also, a slot **6** for a memory card is placed in the left side lower section of the control panel **5**. A memory card is inserted into the slot **6**, and a predetermined manipulation is performed with the control panel **5**, whereby the image data inside the memory card can be displayed on the liquid crystal display screen of the control panel **5**. By manipulating the control panel **5** on the basis of the display, any image can be printed using the printer **2**.

The scanner **3** is a flatbed scanner. The scanner **3** is constituted mainly by an original copy cover **30**, a platen glass **31**, and an image sensor **32** (see FIG. **2**). The platen glass **31** is placed substantially horizontally in the upper section of the complex machine **1**. The image sensor **32** is placed below the platen glass **31**. The image sensor **32** is placed such that the Y direction is the main scanning direction (a direction in which a plurality of light receiving elements are arranged) and the X direction is the sub-scanning direction (a direction along which the image sensor **32** moves). The original copy cover **30** is placed above the platen glass **31**. The original copy cover **30** is opened to set an original copy on the platen glass **31**, whereby an image on the original copy can be read by the image sensor **32**. Moreover, an auto document feeder (ADF) **4** is placed on the original copy cover **30**. The ADF **4** has an original copy tray **14** which can store the plurality of original copies. The ADF **4** conveys original copies one-by-one from the original copy tray **14** onto the platen glass **31**, and thereafter discharges the original copies to a catch tray **15**. While the ADF **4** conveys the original copies, the image sensor **32** reads images of the conveyed original copies. It should be noted that in FIG. **1** the original copy tray **14** is folded up.

The printer **2** prints images or text on a paper on the basis of image data or document data which is inputted from the external computer, external digital camera, scanner **3**, memory card inserted into the slot **6**, and the like.

An opening **10** is formed on a front side of an upper side frame **12** of the printer **2**. In a space inside the opening **10**, a catch tray **21** is formed in an upper section and a feeding tray **20** is formed in a lower section. The feeding tray **20** can store a plurality of papers. Moreover, the feeding tray **20** can store papers of any size such as A4 size, B5 size, postcard size, or other size. Furthermore, by pulling a slide tray **20***a* of the feeding tray **20**, papers of legal size or of relatively large size can also be stored. The papers stored on the feeding tray **20** are conveyed into the printer **2**, and thereby images are printed. The papers with the printed images are discharged to the catch tray **21**.

An opening is formed on the front side of the lower side frame **13** of the printer **2**. A feeding tray **11** is placed within the opening. The feeding tray **11** can store papers of any size such as A4 size, B5 size, legal size, or other size. The feeding tray **11** can also store several times more papers than the feeding tray **20**. Normally, the size of paper which is frequently used, such as A4 size,is stored in the feeding tray **11**.

It should be noted that the lower side frame **13** is detachable with respect to the upper side frame **12**. Among the types of complex machines which are a lower level than the complex machine **1**, there are complex machines which do not have the lower side frame **13** (i.e., the feeding tray **11**).

Next, the internal structure of the complex machine **1** is explained. As shown in FIG. **2**, in the complex machine **1**, there is a structure for sending papers to a printing unit **24**, the printing unit **24** for printing an image on the papers, and a structure for discharging the papers on which the image is printed by the printing unit **24**, to the catch tray **21**. The structure for sending papers is constituted by a first feeding roller **25**, a first feeding arm **26**, a tilted plate **22**, a first paper path **23**, a second feeding roller **89**, a second feeding arm **90**, a tilted plate **82**, a second paper path **83**, a conveying roller **78**, a pinch roller **79** and the like. The structure for discharging the papers is constituted mainly by a discharging roller **80**, a spur roller **81** and the like.

<The Structure for Sending Papers to the Printing Unit **24**>

In the feeding tray **20**, the first feeding arm **26** is placed so as to be rotatable around a shaft **26***a*. The first feeding roller **25** is placed on a distal end of the first feeding arm **26**. The first feeding arm **26** is biased in a lower direction by a spring or the like. Therefore, the first feeding roller **25** is in contact with the paper at the top of the feeding tray **20**. The first feeding roller **25** rotates when driving force of a LF motor **107** is transmitted by a driving force transmitting device **220** which is described hereinafter. The tilted plate **22** is placed at the back of the feeding tray **20**. The first paper path **23** is formed on the upper side of the tilted plate **22** by guide members **18**, **19**.

When the first feeding roller. **25** rotates in a direction feeding a paper, the paper at the top of the feeding tray **20** is sent to the tilted plate **22** side. The sent paper is brought into contact with the tilted plate **22** and then conveyed in an upper direction (i.e., to the first paper path **23**). When two or more papers are sent from the feeding tray **20** to the tilted plate **22** side, the papers other than the very top sheet of paper are prevented from moving by the tilted plate **22**. Therefore, only the very top paper sheet is conveyed to the first paper path **23**. The paper conveyed to the first paper path **23** is conveyed to the conveying roller **78** and pinch roller **79** through the first paper path **23**.

In the feeding tray **11**, the second feeding arm **90** is placed so as to be rotatable around a shaft **90***a*. The second feeding roller **89** is placed on a distal end of the second feeding arm **90**. The second feeding arm **90** is biased in a lower direction by a spring or the like. Therefore, the second feeding roller **89** is in contact with the paper at the top of the feeding tray **11**. The second feeding roller **89** rotates when the driving force of the LF motor **107** is transmitted by the driving force transmitting device **220**. The tilted plate **82** is placed at the back of the feeding tray **11**. The second paper path **83** is formed on the upper side of the tilted plate **82** by the guide member **19** and a guide member **28**. The second paper path **83** merges with the first paper path **23**.

When the second feeding roller **89** rotates, the paper at the top of the feeding tray **11** is conveyed to the conveying roller **78** and pinch roller **79** via the tilted plate **82** and second paper path **83**, as with the paper on the feeding tray **20**.

The conveying roller **78** and pinch roller **79** are placed on the downstream end of the first paper path **23** (which is also the downstream end of the second paper path **83**). The conveying roller **78** is rotated intermittently by the driving force of the LF motor **107**. A rotary encoder **112** (see FIG. **9**) is placed on the conveying roller **78**. The rotary encoder **112** optically detects a rotation amount of the conveying roller **78**. The rotation of the conveying roller **78** is controlled based on a value detected by the rotary encoder **112**. The pinch roller **79** is biased in the direction of the conveying roller **78** by a coil spring which is not shown, and is in contact with the conveying roller **78**. The pinch roller **79** is supported rotatably. Therefore, the pinch roller **79** rotates with the rotation of the conveying roller **78**.

The paper which is sent from the first paper path **23** or second paper path **83** is guided between the conveying roller **78** and the pinch roller **79**. As described above, the conveying roller **78** rotates intermittently. Therefore, the paper is held between the conveying roller **78** and the pinch roller **79** and then conveyed intermittently to the printing unit **24** side. The paper conveyed to the printing unit **24** passes between the printing unit **24** and a platen **42**, and is conveyed to the discharging roller **80** and spur roller **81**. It should be noted that resist processing is performed when the paper passes through the conveying roller **78** and pinch roller **79**.

<The Printing Unit **24**>

The printing unit **24** and the platen **42** are placed on the downstream side of the conveying roller **78** and pinch roller **79**. The printing unit **24** is constituted by a carriage **38** moving in the X direction and an inkjet head **39** placed on the bottom surface of the carriage **38**.

FIG. **3** is a plan view showing a main structure of the printer **2**. FIG. **3** mainly shows a structure between substantially the center of the printer **2** and the bottom thereof. Although not shown, the conveying roller **78** and the pinch roller **79** are placed on the upper side of FIG. **3**, and papers are conveyed from the upper side to the lower side of the FIG. **3** at the time of printing. As shown in FIG. **3**, a pair of guide rails **43**, **44**, which are separated from each other by a predetermined distance, are placed within the printer **2**. The guide rails **43**, **44** extend in the X direction. The guide rails **43**, **44** are part of a frame **40** of the printer **2**. The guide rails **43**, **44** are in the form of a flat plate. The length of the guide rails **43**, **44** is longer than the width of the widest type of paper that might possibly be conveyed. An end section **45** of the guide rail **44** is bent in a vertical direction. The carriage **38** bridges from the guide rail **43** to the guide rail **44**. Specifically, a groove (not shown), which is formed on the bottom surface of the carriage **38**, is in engagement with the end section **45** of the guide rail **44**, and the bottom surface of the carriage **38** is in contact with the guide rails **43**, **44**. In the carriage **38**, a roller and the like are placed in the section which is in contact with the guide rails **43**, **44**. Accordingly, the carriage **38** can reciprocate along the X direction within the range of the length of the guide rails **43**,

44. Therefore, the carriage 38 can reciprocate along the entire width of the paper to be conveyed.

A belt driving device 46 is placed on a top surface of the guide rail 44. The belt driving device 46 is constituted by a driving pulley 47, a driven pulley 48, and a timing belt 49. The driving pulley 47 and the driven pulley 48 are placed on both ends of the guide rail 44 (both ends in the X direction). The driving pulley 47 is rotated by a driving force of a CR motor 109 (see FIG. 9) which is described hereinafter. The timing belt 49 is a circular belt and is placed around the driving pulley 47 and driven pulley 48 so that the timing belt 49 can be rotated around the driving pulley 47 and, driven pulley 48. Irregular teeth are formed on the inside of the timing belt 49. The carriage 38 is fixed To the timing belt 49. When the driving pulley 47 rotates, the timing belt 49 rotates around the driving pulley 47 and driven pulley 48. Accordingly, the carriage 38 moves along the X direction. As described above, the inkjet head 39 is placed on the bottom surface of the carriage 38. Therefore, the inkjet head 39 also moves along the X direction.

An encoder strip 500 is placed on the guide rail 44. The encoder strip 50 is a strip-shaped plate made of transparent resin. The length of the encoder strip 50 is orientated in the X direction. The encoder strip 50 is placed such that the width of the strip is orientated in the vertical direction and the thickness is orientated in the Y direction. The encoder strip 50 is fixed to supporting sections 33, 34, in a state in which both end sections of the encoder strip 50 are pulled. Accordingly, the encoder strip 50 is prevented from being slackened. A pattern for blocking light is formed on the surface of the encoder strip 50. The encoder strip 50 is placed so that the encoder strip 50 engages with the detection section of optical sensor 35 which is placed on the top surface of the carriage 38. The optical sensor 35 has a light emitting element and a light receiving element. The optical sensor 35 uses the light receiving element to detect light emitted by the light emitting device, and thereby detects whether the light is blocked or not, by using the detection section. When the carriage 38 moves along the X direction, the pattern of the encoder strip 50 is detected as a pulse signal by the optical sensor 35. The pulse signal detected by the optical sensor 35 is read by a main control board which is described hereinafter. The main control board computes the position of the carriage 38 on the basis of the read pulse signal. Specifically, a linear encoder 113 is formed by the optical sensor 35 and the encoder strip 50. The main control board drives the CR motor 109 to control the position of the carriage 38, in accordance with the computed position of the carriage 38.

As described above, the inkjet head 39 is placed on the bottom surface of the carriage 38. The inkjet head 39 is connected to an ink cartridge by four ink tubes 41 (see FIG. 3).

The four ink tubes 41 are synthetic resin tubes. The ink tubes 41 connect the inkjet head 39 to the ink cartridge. The vicinity of an end section of each ink tube 41 on the inkjet head 39 side is fixed to the carriage 38. The middle section of each of the four ink tubes 41 is fixed to the frame 40 of the printer 2 by a clip 36. A section of each ink tube 41 between the carriage 38 and the clip 36 is sufficiently slackened. Moreover, the section of the ink tube 41 between the carriage 38 and the clip 36 is supported by a supporting member 87. The supporting member 87 can rotate horizontally around an axis 88. Accordingly, the ink tubes 41 are prevented from disengaging as the carriage 38 travels along the X direction. Also, in the frame 40 of the printer 2, a wall 37 is formed in the vicinity of the ink tubes 41. The height of the wall 37 corresponds to the four ink tubes 41. The wall 37 prevents the ink tubes 41 from protruding into the outer region of the printer 2. Also, a flat cable 85 is attached inside the printer 2 in the same manner as the ink tubes 41. The flat cable 85 is a wiring member formed by covering a plurality of conductive lines transmitting electrical signals with a polyester film. The flat cable 85 electronically connects a head control board to the main control board which is described hereinafter.

A cartridge attachment location is formed inside the printer 2. As shown in FIG. 1, a section above a grip 7 of the complex machine 1 can be rotated relatively in the direction of the arrow 8 with respect to a section below, the grip 7. Accordingly, the cartridge attachment location inside the printer 2 is exposed. Although not shown, the cartridge attachment section has four storage chambers. Ink cartridges for colors of cyan (C), magenta (M), yellow (Y) and black (Bk) are stored in each of the storage chambers. The ink tubes 41 are connected one-by-one to each cartridge. Therefore, ink is supplied from each cartridge to the inkjet head 39. Specifically, four colors of inks: cyan, magenta, yellow, and black, are supplied to the inkjet head 39.

FIG. 8 is a view showing a frame format of an enlarged cross section of part of the inkjet head 39. As shown in FIG. 8, opening 76 for receiving the ink supplied from the ink tubes 41, and a buffer tank 75 for accumulating the supplied ink are formed inside the inkjet head 39. The opening 76 and the buffer tank 75 are formed for each color independently. Moreover, a plurality of manifolds 74, whose upstream ends are connected to the buffer tanks 75 respectively, are formed inside the inkjet head 39. The downstream side of each of the manifolds 74 branches off in a plurality of directions. Each of the branch flow paths is opened to a bottom surface of the inkjet head 39. The opening of the each branch flow path is constituted as a nozzle 70 for ejecting ink droplets. A cavity 73 is formed in the middle of the each branch flow path. As shown in the figure, the manifolds 74 and the branch flow paths are filled with the ink. A piezoelectric element 72 is placed on a top surface of the cavity 73. The piezoelectric element 72 is deformed when predetermined voltage is applied thereto. When the piezoelectric element 72 is deformed, the volume of the cavity 73 decreases.

FIG. 7 shows the bottom surface of the inkjet head 39. As shown in the figure, a number of nozzles 70 are formed on the bottom surface of the inkjet head 39. The abovementioned branch flow path is formed for each nozzle. The nozzles 70 are arranged in the Y direction for each color of ink to be ejected. Also, a row of nozzles for each color is arranged in the X direction. The pitch of the nozzles 70 for each color is determined in accordance with the resolution and the like of the printer 2.

The ink supplied from the ink tubes 41 to the inkjet head 39 is accumulated in the buffer tanks 75. Bubbles in the ink float upward in each of the buffer tanks 75. Therefore, ink with relatively less bubbles is present in the lower section of the buffer tank 75. The ink inside the buffer tank 75 flows out from the lower section into each manifold 74. Therefore, the bubbles are prevented from flowing into the manifold 74. The ink that flowed into the manifold 74 then flows into each branch flow path. Voltage is applied from the head control board to the piezoelectric element 72 at the time of printing. Consequently, the piezoelectric element 72 is deformed, and the volume of the cavity 73 decreases. Accordingly, the ink inside the cavity 73 is pressurized, and thereby ink droplets are, ejected from the nozzles 70.

Moreover, as shown in FIG. 8, a discharge flow path 77, one end of which is connected to the buffer tank 75, is formed inside the inlet head 39. The other end of the discharge flow path 77 is connected to a discharge port 71 shown in FIG. 7.

The discharge flow path **77** and the discharge port **71** are formed for each color (i.e., for each buffer tank **75**). A check valve, which is not shown, is placed in each discharge port **71**. This check valve is opened by inserting a rod **60** of a purging device **51** when maintenance is performed, the purging device **51** being described hereinafter. The air inside the buffer tank **75** (including the bubbles) is drawn and eliminated by the purging device **51**.

As shown in FIG. **2** and FIG. **3**, the platen **42** is placed on the lower side of the printing unit **24**. The platen **42** is placed in a central part of the moving range of the carriage **38**, the central part being a section through which a paper passes. The width of the platen **42** (width of the X direction) is wider than the width of a paper to be conveyed (the width of a paper, which is the widest among the papers which might be conveyed).

As described above, a paper to be conveyed by the conveying roller **78** and pinch roller **79** passes between the printing unit **24** and the platen **42**. At this moment, the position of the carriage **38** in the X direction is controlled, and voltage is applied to each piezoelectric element **72** of the inkjet head **39**. Accordingly, ink droplets are ejected from the nozzles **70**. Paper feed rate, the position of the carriage **38**, and the nozzles **70** ejecting ink droplets are controlled in accordance with an image to be printed. Therefore, an image is printed on a paper by an ink droplet ejected from each nozzle **70**.

<The Structure for Discharging Papers to the Catch Tray **21**>

The discharging roller **80** and the spur roller **81** are placed on the downstream side of the printing unit **24** and platen **42**. The discharging roller **80** is rotated intermittently by the driving force of the LF motor **107**. Rotation of the discharging roller **80** is synchronized with rotation of the conveying roller **78**. Concavities and convexities are formed on the surface of the spur roller **81**. The spur roller **81** is biased in the direction of the discharging roller **80** by a coil spring which is not shown, and is in contact with the discharging roller **80**. The spur roller **81** is supported so as to be able to rotate freely. Therefore, the spur roller **81** rotates with rotation of the discharging roller **80**.

The discharging roller **80** and the spur roller **81** convey a paper that has passed through the printing unit **24** to the catch tray **21**. The paper that has passed through the printing unit **24** is held between the discharging roller **80** and the spur roller **81**, and conveyed intermittently to the catch tray **21**. It should be noted that an image is printed on an upper surface of the paper that has passed through the printing unit **24**. Therefore, the spur roller **81** is brought into contact with the section of the paper where the image is printed. However, since the concavities and convexities are formed on the surface of the spur roller **81**, distortion of the image, which is caused by contact with the spur roller **81**, is prevented from occurring.

As described above, the printer **2** prints an image on the papers stored in the feeding tray **20** or the feeding tray **11**. It should be noted that, when printing an image on the papers stored in the feeding tray **11**, the printer **2** can perform the printing in two modes: normal print mode and high-speed print mode (i.e., a mode in which the intervals for conveying the papers are set shorter than those of the normal print mode, to print an image). In the normal print mode, a printed paper is discharged to the catch tray **21**, and thereafter the next paper is sent from the feeding tray **20**. In the high-speed print mode, on the other hand, immediately after a paper is sent from the feeding tray **20**, the next paper is sent. In the high-speed print mode, the interval between papers is shorter than that in the normal print mode, thus a number of papers can be printed in a short amount of time.

<The Purging Device **51** and a Waste Ink Tray **84**>

As shown in FIG. **3**, the purging device **51** is placed on a right end of the moving range of the printing unit **24** (the position through which a paper does not pass). Also, a waste ink tray **84** is placed on a left end of the moving range of the printing unit **24** (the position through which the paper does not pass).

FIG. **4** is a plan view off the purging device **51**. FIG. **5** is a V-V cross-sectional view of FIG. **4**. FIG. **6** shows the purging device **51** in which a nozzle cap **52** and a discharge cap **53** are lifted up. The purging device **51** draws and eliminates bubbles or foreign material from the inkjet head **39**. As shown in FIGS. **4** through **6**, the purging device **51** has the nozzle cap **52**, discharge cap **53**, a pump **54**, a lift-up device **55**, and a wiper blade **56**.

The nozzle cap **52** is a rubber cap, which is shaped so as to be sealable around a nozzle surface **70***a* (a region **70***a* in FIG. **7**) of the inkjet head **39**. The inside of the nozzle cap **52** is divided into a region corresponding to the nozzles **70** ejecting the color inks (the nozzles **70** for CMY shown in FIG. **7**) and a region corresponding to the nozzle **70** ejecting the black ink (the nozzle **70** for Bk shown in FIG. **7**). Members **57**, **58** for supporting the nozzle cap **52** are embedded in the two regions respectively. Also, air inlets are formed on a bottom section of each region. Each of the air inlets is connected to a port switching device **59** via an inlet passage.

The discharge cap **53** is a rubber cap, which is shaped so as to be scalable around the region where four discharge ports **71** of the inkjet head **39** are formed (a reference numeral **71***a* in FIG. **7**). In the discharge cap **53**, the push rod **60** is placed in a position corresponding to each discharge port **71**. Each push rod **60** extends vertically upward. Each push rod **60** can move in a vertical direction. An air inlet **61** is formed on a bottom section of the discharge cap **53**. The air inlet **61** is connected to the port switching device **59** via an inlet passage.

The port switching device **59** is connected to an inlet passage connected to each air inlet of the nozzle cap **52** (referred to as "inlet passage of the nozzle cap **52**" hereinafter), an inlet passage connected to the air inlet **61** of the discharge cap **53** (referred to as "inlet passage of the discharge cap **53**" hereinafter), and an inlet passage connected to the pump **54** (referred to as "inlet passage of the pump **54**" hereinafter). The port switching device **59** switches between a state in which the inlet passage of the nozzle cap **52** is connected to the inlet passage of the pump **54** and a state in which these inlet passages rare blocked. Moreover, the port switching device **59** switches between a state in which the inlet passage of the discharge cap **53** is connected to the inlet passage of the pump **54** and a state in which these inlet passages are blocked.

The pump **54** is a rotary pump. The pump **54** is connected to the port switching device **59** via an inlet passage. The pump **54** has a pump gear. The pump gear is in engagement with a bevel gear **62** shown in FIG. **4**. The pump gear is rotated by rotation of the bevel gear **62**. When the pump gear is rotated the pump **54** draws the liquid (and gas) inside the inlet passage to reduce the pressure inside the inlet passage. The bevel gear **62** is rotated when the driving force of the LF motor **107** is transmitted by the driving force transmitting device **220**.

The lift-up device **55** moves a holder **63** to which the nozzle cap **52** and discharge cap **53** are fixed. The lift-up device **55** uses a rotating member **64** to rotate the holder **63** between a waiting position shown in FIG. **5** and an adhesion position shown in FIG. **6**. The holder **63** is normally biased by a spring and fixed to the waiting position. The lift-up device **55** has a lever **65**. Although described hereinafter, the carriage **38** contacts with the lever **65** when the carriage **38** moves to a position at a right end of FIG. **3**. When the carriage **38** contacts with the lever **65**, the holder **63** is moved from the waiting position to the adhesion position by the lift-up device **55**. When the holder **63** is moved to the adhesion position, the nozzle cap **52** and discharge cap **53** adhere to the inkjet head **39**. At this moment, the nozzle cap **52** and discharge cap **53** are pressed against the inkjet head **39** by coil springs **66**, **67**. Accordingly, the airtightness within the nozzle cap **52** and within the discharge cap **53** is maintained.

The wiper blade **56** is normally stored in a wiper holder **68**. The wiper blade **56** can move upward from the wiper holder **68**. The wiper blade **56** is a plate member made of rubber. When the wiper blade **56** protrudes from the wiper holder **68** at the time that the carriage **38** is at the right end of FIG. **3**, the end section of the wiper blade **56** makes contact with the bottom surface of the inkjet head **39**. When the carriage **38** is moved to the left of FIG. **3** in such a state, the bottom surface of the inkjet head **39** is wiped by the wiper blade **56**.

When drawing and eliminating bubbles, foreign material and the like from the inkjet head **39**, the carriage **38** moves to the position at the right end of FIG. **3**. Accordingly, the inkjet head **39** is moved to the position right above the purging device **51**. At this moment, since the carriage **38** contacts with the lever **65**, the holder **63** moves from the waiting position to the adhesion position. Accordingly, the nozzle cap **52** and discharge cap **53** adhere to the inkjet head **39**. In this state, bubbles, foreign mattes and the like are drawn from the nozzle **70** or discharge port **71**.

When drawing bubbles, foreign material and the like from the nozzle **70**, the inlet passage of the nozzle cap **52** is connected to the inlet passage of the pump **54** by the port switching device **59**. Then, the driving force of the LF motor **107** is transmitted to the pump **54** by the driving force transmitting device **220**. Accordingly, the pump **54** executes drawing, whereby bubbles, foreign material and the like are drawn along with ink from each nozzle **70**.

When drawing bubbles, foreign material and the like from the discharge port **71**, the inlet passage of the discharge cap **53** is connected to the inlet passage of the pump **54** by the port switching device **59**. Then, the driving force of the LF motor **107** is transmitted to the pump **54** by the driving force transmitting device **220**. Accordingly, the pump **54** executes drawing, whereby bubbles, foreign material and the like are drawn along with ink from each discharge port **71**.

When the drawing operation has ended, the carriage **38** is moved to the left of FIG. **3**. When the carriage **38** separates from the lever **65**, die holder **63** moves to the waiting position. Consequently, the wiper blade **56** protrudes outward and makes contacts with the bottom surface of the inkjet head **39**. The carriage **38** is then moved, whereby inks adhered to the bottom surface of the inkjet head **39** are wiped by the wiper blade **56**.

As shown in FIG. **3**, the waste ink tray **84** is placed in the position at a left end of the moving range of the printing unit **24** (the position through which a paper does not pass). In order to prevent jamming of the nozzles **70** of the inkjet head **39**, sometimes ink droplets are ejected from the nozzles **70** at times other than printing (referred to as "flashing" hereinafter). The waste ink tray **84** receives ink droplets ejected by flashing. A felt is laid inside the waste ink tray **84**. The ink droplets ejected by flashing are absorbed into the felt.

<The Control System of the Complex Machine **1**>

FIG. **9** is a block diagram showing the control system of the complex machine **1**. A control section **100** controls the entire complex machine **1** comprising the printer **2** and scanner **3**. It should be noted that the control of the scanner **3** is not a part of the main structure of the present invention, thus the explanation thereof is omitted. The control section **100** is constituted by a microcomputer having a CPU (Central Processing Unit) **101**, ROM (Read Only Memory) **102**, RAM (Random Access Memory) **103**, EEPROM (Electrically Erasable and Programmable ROM) **104**. The microcomputer is connected to an ASIC (Application Specific Integrated Circuit) **106** via a bus **105**.

The programs and the like for controlling various operations of the complex machine **1** are stored in the ROM **102**. For example, a program controlling each part of printer **2** in the normal printing mode and the high-speed printing mode is stored in the ROM **102**. Also, a program controlling each part of printer **2**, which is used for printing the papers stored in the feeding tray **11** and performing the purging operation, is stored in the ROM **102**. The RAM **103** temporarily stores various data items which are used when the CPU **101** executes the programs. For example, when printing an image, data indicating the conditions for conveying papers and the printing resolution, are stored temporarily in the RAM **103**. Further, the EEPROM **104** stores setting, flags, and the like which should be kept after turning off the power.

The ASIC **106** is connected to the control section **100** and each part of the complex machine **1**. The ASIC **106** outputs a control signal to each part of the complex machine **1** in accordance with a command sent from the control section **100**. The control section **100** and ASIC **106** are mounted on the main control board which is not shown.

A drive circuit **108** is connected to the ASIC **106** and the LF motor **107**. The drive circuit **108** controls the drive of the LF motor **107** in response to the control signal inputted from the ASIC **106**.

The LF motor **107** is a motor controlled by the drive circuit **108**. The driving force of the LP motor **107** is transmitted to the conveying roller **78** and discharging roller **80**. When printing is executed, the ASIC **106** computes a rotation amount for the conveying roller **78** and for the discharging roller **80** from the detection signal from the rotary encoder **112**. Then, the ASIC **106** outputs a control signal to the drive circuit **108** in accordance with the computed rotation amount. The drive circuit **108** drives the LF motor **107** in response to the inputted control signal. Therefore, the rate at which a paper is fed by the conveying roller **78** and discharging roller **80** is controlled.

Moreover, the driving force of the LF motor **107** is transmitted to the purging device **51**, first feeding roller **25**, or second feeding roller **89** by the driving force transmitting device **220**. The driving force transmitting device **220** switches the destination for transmitting the driving force of the LF motor **107** (i.e., the purging device **51**, first feeding roller **25**, or second feeding roller **89**).

A drive circuit **110** controls the drive of the CR motor **109** in response to the control signal inputted from the ASIC **106**. The driving force of the CR motor **109** is transmitted to the belt driving device **46**. Accordingly, the carriage **38** is moved. Furthermore, the ASIC **106** computes the position of the carriage **38** from a detection signal detected by the linear encoder **113**. The ASIC **106** inputs a control signal to the drive circuit **110** in accordance with the computed position of the carriage **38**. The drive circuit **110** controls the drive of the CR motor **109** in response to the inputted control signal. Accordingly, the position of the carriage **38** is controlled.

A drive circuit **111** is mounted on the head control board. A control signal is inputted from the ASIC **106** into the drive circuit **111** via the flat cable **85**. The drive circuit **111** controls each piezoelectric element **72** of the inkjet head **39** in response to the control signal inputted from the ASIC **106**. Specifically, the drive circuit **111** controls the ejection of ink droplets performed by the inkjet head **39**.

Moreover, the scanner **3**, the control panel **5**, the slot **6**, a parallel interface **114**, a USB interface **115**, and a NCU (Network Control Unit) **116** are connected to the ASIC **106**. External equipment such as a personal computer is connected to the parallel interface **114** and USB interface **115**. The NCU **116** is connected to a MODEM **117** and an external line.

<The Driving Force Transmitting Device **220**>

As described above, the driving force transmitting device **220** transmits the driving force of the LP motor **107** to the purging device **51**, first feeding roller **25**, or second feeding roller **89**. The driving force transmitting device **220** switches the driving method of the first feeding roller **25** between the normal printing mode and the high-speed printing mode. The driving force transmitting device **220** is described hereinafter.

As shown in FIG. **10**, the driving force transmitting device **220** is constituted by the conveying roller **78** which is rotated by the LF motor **107**, a drive gear **120** placed on the end section of the conveying roller **78**, a switch gear **121** for switching the destination for transmitting the driving force of the LF motor **107**, a set of driven gears placed on a shaft **122** (a first driven gear **123**, second driven gear **124**, third driven gear **125**, and fourth driven gear **126**), a first mechanism, a second mechanism, a third mechanism, and a fourth mechanism. The first mechanism is a mechanism for rotating the first feeding roller **25** in the normal printing mode, and is constituted by a plurality of gears. The second mechanism is a mechanism for rotating the first feeding roller **25** in the high-speed printing mode, and is constituted by a plurality of gears. A third mechanism is a mechanism for rotating the second feeding roller **89** and is constituted by a plurality of gears. The fourth mechanism is a mechanism for activating the purging device **51**, and is constituted by a plurality of gears.

It should be noted that teeth of each gear are omitted in FIG. **10**. Also, illustration of teeth of each gear is omitted in the figures subsequent to FIG. **10**. Moreover, each gear described hereinafter is a spur gear unless otherwise stated.

Although not shown, the LF motor **107** is placed in the vicinity of the end section of the conveying roller **78** (the end section on the far side in FIG. **10**). The driving force of the LF motor **107** is transmitted to the conveying roller **78** via a deceleration gear. Therefore, the conveying roller **78** rotates when the LF motor **107** rotates. The drive gear **120** is fixed on other end of the conveying roller **78**. As shown in the figure, the width of the drive gear **120** is wider than the switch gear **121** (specifically, the width of the drive gear **120** is comparatively long in the direction parallel to the rotation axis). The drive gear **120** rotates along with the conveying roller **78**.

The switch gear **121** is placed adjacent to the drive gear **120**. The switch gear **121** is supported rotatably around a shaft **137** which is parallel to the rotation axis of the drive gear **120** (i.e., the conveying roller **78**). The switch gear **121** is in engagement with the drive gear **120**. The width of the switch gear, **121** is narrower than that of the drive gear **120**. The switch gear **121** can slide along a direction parallel to the rotation axis in a state in which the switch gear **121** is in engagement with the drive gear **120**. The switch gear **121** can slide within the range of the width of the drive gear **120**.

The set of driven gears (the first driven gear **123**, second driven gear **124**, third driven gear **125**, and fourth driven gear **126**) are placed obliquely below the drive gear **120**. The driven gears **123** through **126** are supported rotatably around the shaft **122** which is parallel to the rotation axis of the drive gear **120**. As shown in FIG. **4**, the shaft **122** is formed in the purging device **51**. It should be noted that the shaft **122** may be provided in the device frame **40**.

As shown in FIG. **14**, the driven gears **123** through **126** are arranged in parallel. The driven gears **123** through **126** are spur gears of equal diameter. However, a bevel gear surface **136** is formed on a side face of the fourth driven gear **126** (see FIG. **15**). The driven gears **123** through **126** can rotate independently. As described above, the switch gear **121** can slide along a direction parallel to the rotation axis thereof. If the switch gear **121** is positioned in the first position (position shown in FIG. **14**), the switch gear **121** will engage with the first driven gear **123**. Therefore, when the switch gear **121** is positioned in the first position, the first driven gear **123** is rotated by the rotation of the switch gear **121**. When the switch gear **121** is positioned in the second position (position shown in FIG. **16**), the switch gear **121** will engage with the second driven gear **124**. When the switch gear **121** is positioned in the third position (position shown in FIG. **18**), the switch gear **121** will engage with the third driven gear **125**. When the switch gear **121** is positioned in the fourth position (position shown in FIG. **20**), the switch gear **121** will engage with the fourth driven gear **126**. Switch gear **121** engages with different driven gears by sliding between the first position, second position, third position, and fourth position.

As shown in FIG. **11**, the first mechanism is constituted by gears **127**, **128**, **129**, and a gear group (not shown) arranged inside the first feeding arm **26**. The gear **127** is in engagement with the first driven gear **123**. The gears **127** and **128** are placed at the back of a supporting member **96** (inside of the device) shown in FIG. **10**. The gear **127** is supported by a shaft **97**. The gear **128** is supported by a shaft **98**. The gear **129** is fixed to one end of the shaft **26*a***. The shaft **26*a*** extends in the directions shown in FIG. **10** and functions as a pivot shaft of the first feeding arm **26** (see FIG. **2**). One of the gears of the gear group inside the first feeding arm **26** is fixed to other end of the shaft **26*a***. The gear group is arranged tandem from the shaft **26*a*** toward the first feeding roller **25**.

When the switch gear **121** rotates at the first position, the first driven gear **123** rotates. When the first driven gear **123** rotates, driving force thereof is transmitted to the gear **129** via the gears **127**, **128**. Accordingly, the gear **129** rotates. Since the gear **129** is fixed to the shaft **26*a***, the shaft **26*a*** rotates when the gear **129** rotates. When the shaft **26*a*** rotates, driving force is transmitted to the first feeding roller **25** via the gear group inside the first feeding arm **26**. Specifically, the first feeding roller **25** rotates.

As shown in FIG. **12**, the second mechanism is constituted by gears **130**, **129**, and the gear group arranged inside the first feeding arm **26**. The second driven gear **124** is in engagement with the second mechanism. The gear **130** is placed on the near side of the supporting member **96** (outside of the device) as shown in FIG. **10** The gear **130** is supported by a shaft **99**. The gear **129** and the gear group inside the first feeding arm **26** are shared with the first mechanism.

When the switch gear **121** rotates at the second position, the second driven gear **124** rotates. When the second driven gear **124** rotates, driving force thereof is transmitted to the first feeding roller **25** by the gears **130**, **129**, and the gear group. Accordingly, the first feeding roller **25** rotates.

As described above, both the first mechanism and the second mechanism transmit a driving force to the first feeding roller **25**. In the first mechanism, the two gears **127**, **128** are placed between the first driven gear **123** and the gear **129**. In the second mechanism, only the gear **130** is placed between the second driven gear **124** and the gear **129**. Therefore, the direction in which the first feeding roller **25** rotates changes depending upon if the first mechanism or the second mechanism is used.

In the normal printing mode, the driving force is transmitted to the first feeding roller **25** by the first mechanism. In the normal printing mode, the LF motor **107** rotates in the opposite direction. Therefore, the conveying roller **78** rotates in the opposite direction (i.e., the direction opposite to the direction of conveying a paper). On the other hand, when the LF motor **107** rotates in the opposite direction, the first feeding roller **25** to which the driving force is transmitted by the first mechanism rotates in a forward direction (i.e., the direction of conveying a paper). Therefore, the papers are conveyed from the feeding tray **20** to the conveying roller **78** and pinch roller **79**. When the conveyed paper makes contact with the conveying roller **78** and pinch roller **79**, the paper stops. At this moment, the first feeding roller **25** is in contact with the paper which is being sent, and rotates in aimless circles on the paper. The resist processing is performed by bringing the paper into contact with the conveying roller **78** and pinch roller **79**. When the resist processing is ended, the direction of rotation of the LP motor **107** is switched. Specifically, the LF motor **107** rotates in a forward direction (i.e., the direction of conveying the paper). Consequently, the conveying roller **78** rotates in the forward direction. On the other hand, the first feeding roller **25** rotates in the opposite direction. The conveying force of the conveying roller **78** and pinch roller **79** is stronger than that of the first feeding roller **25**. Therefore, the paper is conveyed to the printing unit **24** (at this moment, the first feeding roller **25** rotates in aimless circles). When printing a plurality of papers, after the first paper is discharged to the catch tray **21**, the LF motor **107** rotates in the opposite direction again. Accordingly, a subsequent paper is sent from the feeding tray **20**.

In the high-speed printing mode, the driving force is transmitted to the first feeding roller **25** by the second mechanism. In the high-speed printing mode, the LF motor **107** rotates in the forward direction. Moreover, the first feeding roller **25** to which the driving force is transmitted by the second mechanism also rotates in the forward direction. Therefore, a paper is conveyed from the feeding tray **20** to the conveying roller **78** and pinch roller **79**. The conveyed paper is conveyed to the printing unit **24** by the conveying roller **78** and pinch roller **79**. Specifically, the paper does not stop at the conveying roller **78** and pinch roller **79**. Therefore, the resist processing is not performed. Moreover, the paper conveying speed of the conveying roller **78** and pinch roller **79** is faster than that of the first feeding roller **25**. Therefore, when the paper is held between the conveying roller **78** and the pinch roller **79**, the first feeding roller **25** rotates in aimless circles. Furthermore, when the paper is completely sent out from the feeding tray **20**, the first feeding roller **25** makes contact with a subsequent sheet of paper. Therefore, the subsequent sheet of paper is sent by the first feeding roller **25**. Specifically, once the previous sheet of paper is sent, the subsequent sheet of paper is sent from the feeding tray **20**. As described above, the paper conveying speed of the conveying roller **78** and pinch roller **79** is faster than that of the first feeding roller **25**. Therefore, a predetermined gap is formed between the previous sheet of paper and the subsequent sheet of paper. Therefore, the papers are prevented from being sent in an, overlapped state.

As shown in FIG. **13**, the third mechanism is constituted by gears **131** through **135** and a gear group (not shown) arranged inside the second feeding arm **90**. The gear **131** is in engagement with the third driven gear **125**. The gear **135** is fixed to one end of the shaft **90***a*. The shaft **90***a* extends in the X direction as shown in FIG. **13** and functions as a pivot shaft for the second feeding arm **90** (see FIG. **2**). One of the gears in the gear group inside the second feeding arm **90** is fixed to other end of the shaft **90***a*. The gear group is arranged in tandem from the shaft **90***a* toward the second feeding roller **89**.

When the switch gear **121** rotates at the third position, the third driven gear **125** rotates. When the third driven gear **125** rotates, driving force is transmitted to the gear **135** via the gears **131** through **134**. Accordingly, the gear **135** rotates. Since the gear **135** is fixed to the shaft **90***a*, the shaft **90***a* also rotates. When the shaft **90***a* rotates, driving force is transmitted via the gear group, and thereby the second feeding roller **89** rotates. Accordingly, the paper in the feeding tray **11** are conveyed. It should be noted that printing the paper stored in the feeding tray **11** is performed in the normal printing mode.

The fourth mechanism is constituted by the bevel gear **62** of the purging device **51** (see FIG. **4**), and the pump gear of the pump **54**. The bevel gear **62** is in engagement with the bevel gear surface **136** of the fourth driven gear **126**. Further, the bevel gear **62** is in engagement with the pump gear of the pump **54**.

When the switch gear **121** rotates at the fourth position, the fourth driven gear **126** rotates. Consequently, the bevel gear **62** rotates and the pump gear rotates. When the pump gear rotates, the pump performs drawing. Specifically, the purging device is activated.

It should be noted that the fourth mechanism transmits a larger driving force, as compared to the first through third mechanisms (i.e., the fourth driven gear **126** transmits a larger driving force, as compared to the driven gears **123** through **125**). Furthermore, the driving force may be transmitted from the fourth driven gear **126** to the port switching device **59** to perform switching of the inlet passages.

As described above, the switch gear **121** slides, and then the switch gear is selects a driven gear to engage with, whereby the operation executed by the printer **2** is determined.

<Structure for Sliding the Switch Gear **121**>

Next, the structure for sliding the switch gear **121** is explained. As shown in FIGS. **14** and **15**, a lever member **138** and a fixing member **139** are placed on the shaft **137**. A lever guide **150** is placed in the upper section of the lever member **138** and the fixing member **139**.

As shown in FIG. **3**, the guide member **92** is placed in the carriage **38**. Therefore, the guide member **92** is moved by movement of the carriage **38**. The guide member **92** moves along a direction of an arrow **159** shown in FIG. **14**. An inclined surface **93** and a cut-out section **94** are formed on one end section of the guide member **92**. When the guide member **92** moves along the direction of the arrow **159**, the inclined surface **93** is brought into contact with a lever **141**.

As shown in FIGS. **14**, **15**, the lever guide **150** is placed in the upper section of the shaft **137**. The lever guide **150** is attached to a mounting hole **91** formed on a guide rail **43** shown in FIG. **3** (the lever guide **150** is omitted in FIG. **3**). The lever guide **150** is a plate-like member. A guide hole **151** is formed on the lever guide **150**. A first guide shape **152**, second guide shape **153**, third guide shape **154**, and fourth guide shape **155** are formed on the guide hole **151**. A return guide **157** is formed on the opposite side of the second guide shape **153** and the third guide shape **154** of the guide hole **151** (an edge section **158** shown in FIG. **14**).

FIG. **22** shows a perspective view of the lever member **138** and fixing member **139**. As shown in FIG. **22**, the lever member **138** has a cylinder **140** and a lever **141** protruding from the cylinder **140**. A rib **142** is formed on a base end of the lever **141**. As shown in FIGS. **14**, **15**, the shaft **137** is inserted into the cylinder **140**. Accordingly, the lever **138** can slide with respect to the shaft **137**. Specifically, the lever member **138** can rotate with respect to the shaft **137** and slide along the direction in which the shaft **137** extends. Moreover, the lever **141** of the lever member **138** is inserted into the guide hole **151** of the lever guide **150**.

As shown in FIG. **22**, the fixing member **139** has a cylinder **143** and a slide guide **144** protruding from the cylinder **143**. The inner diameter of the cylinder **143** is larger, on the lever member **138** side, than the outer diameter of the cylinder **140** of the lever member **138**. Furthermore, at the end section **146** of the cylinder **143**, the inner diameter is smaller than the outer diameter of the cylinder **140** of the lever member **138**. A section of the end section on the lever member **138** side of the cylinder **143** is cut out (a cut-out section **145**), this section corresponds with the slide guide **144**. As shown in FIGS. **14**, **15**, the cylinder **140** of the lever member **138** is inserted into the cylinder **143**. Accordingly, the fixing member **139** can slide with respect to the lever member **138**. The lever member **138** is inserted into the fixing member **139** such that the rib **142** is positioned on the cut-out section **145** of the fixing member **139**. Moreover, a distal end of the slide guide **144** is split into two parts, and the lever guide **150** is fitted between the two parts. Accordingly, the fixing member **139** is prevented from rotating around the shaft **137**.

The fixing member **139** is biased to the lever member **138** side (a direction of an arrow **147** shown in FIG. **14**) by a spring which is not shown. Furthermore, the switch gear **121** is biased to the lever member **138** side (a direction of an arrow **148** shown in FIG. **14**) by another spring which is not shown. The force that biases the fixing member **139** is stronger than the force that biases the switch gear **121**. Moreover, when the fixing member **139** is biased to the lever member **138** side, a force acts from the cut-out section **145** onto the rib **142**. This force attempts to rotate the lever **141** in the direction of the arrow **149** shown in FIG. **14**.

FIGS. **14**, **15** show a state in which the switch gear **121** is in engagement with the first driven gear **123**. In such a state, the lever **141** of the lever member **138** is brought into contact with the left edge within the guide hole **151** (the position of the first guide shape **152** shown in FIG. **14**) by the biasing force of the, fixing member **139** (the force indicated by the arrow **147**) and the force applied to the rib **142** (the force indicated by the arrow **149**). Accordingly, the position of the lever member **138** is fixed. Moreover, since the switch gear **121** is biased to the lever member **138** side, the position of the switch gear **121** is also fixed. Therefore, the condition in which the switch gear **121** is in engagement with the first driven gear **123** is maintained. In such a state, the driving force is transmitted to the first mechanism.

When the guide member **92** moves along the direction of the arrow **159** and the inclined surface **93** of the guide member **92** makes contact with the lever **141**, the lever **141** is pressed by the guide member **92** and moves along the direction of the arrow **159**. As shown in the figure, the inclined surface **93** is inclined toward the lever **141**. Therefore, while the lever **141** is pressed against the inclined surface **93**, a force in the direction indicated by the arrow **149** acts from the inclined surface **93** onto the lever **141**. Moreover, as described above, the force in the direction indicated by the arrow **149** also acts on the rib **142** of the lever **141**. If the lever **141** is pressed by the guide member **92** by a predetermined distance, the lever **141** is moved into the second guide shape **153** by the force indicated by the arrow **149** (see FIGS. **16**, **17**). If the guide member **92** returns to its original position after the lever **141** moves into the second guide shape **153** (i.e., if the guide member **92** moves in the opposite direction from the direction of the arrow **159**), the lever **141** is supported by the second guide shape **153**. Specifically, the lever **138** and fixing member **139** stop at the positions shown in FIGS. **16**, **17**. Furthermore, the switch gear **121** is biased in the direction of the lever member **138** (the direction of the arrow **148**). Therefore, the switch gear **121** slides when the lever **138** moves. When the lever **141** is supported by the second guide shape **153**, it causes the switch gear **121** to engage with the second driven gear **124** as shown in FIGS. **16**, **17**. In such a state, the driving force is transmitted to the second mechanism.

When the guide member **92** further moves the lever **141** in the direction of the arrow **159** by a predetermined amount, the lever **141** is moved into the third guide shape **154** (see FIGS. **18**, **19**). If the guide member **92** returns to its original position after the lover **141** moves into the third guide shape **154**, the lever **141** is supported by the third guide shape **154**. Specifically, the lever **138** and fixing member **139** stop at the positions shown in FIGS. **18**, **19**. Furthermore, when the lever **141** is supported by the third guide shape **154**, it causes the switch gear **121** to engage with the third driven gear **125** as shown in FIGS. **18**, **19**. In such a state, the driving force is transmitted to the third mechanism.

When the guide member **92** moves the lever **141** toward the fourth guide shape **155** side, the lever **141** slides along with a guide shape **155*a*** of the guide hole **151**. At this moment, as a result of being guided by the guide shape **155*a***, the lever **141** slightly rotates in a direction opposite the direction of the arrow **149**. Accordingly, this causes the lever **141** to engage with the cut-out section **94** of the guide member **92**. Then, the lever **141** moves into the fourth guide shape **155** as shown in FIGS. **20**, **21**. When the lever **141** is positioned at the fourth guide shape **155**, the lever **141** is supported by the cut-out section **94** of the guide member **92**, whereby the position of the lever **141** is fixed. When the lever **141** is fixed in the fourth guide shape **155**, the lever member **138** and fixing member **139** stop at the positions shown in FIGS. **20**, **21**. Furthermore, the switch gear **121** is slid along with the lever member **138** by a biasing force (force indicated by the arrow **148**), and, while moving, brought into contact with a restricting surface **156** formed on the fourth driven gear **126**. Accordingly, this causes the switch gear **121** to engage with the fourth driven gear **126**. Moreover, since the lever **138** is further moved along the direction of the arrow **148**, the fourth driven gear **126** is separated from the lever member **138** (FIGS. **20**, **21**). In such a state, the driving force is transmitted to the fourth mechanism.

If the guide member **92** moves in a direction of an arrow **160** from the state shown in FIG. **20**, the lever **141** is moved in the direction of the arrow **147** by the biasing force (the force indicated by the arrow **147**). Specifically, the lever member **138** and fixing member **139** move along the direction of the arrow **147**. Consequently, the lever **138** makes contact with the switch gear **121**, and the switch gear **121** also slides along in the direction of the arrow **147**. The lever **141** is brought into contact with the return guide **157** while, moving, and then separates from the guide member **92**. Thereafter, the lever **141** is guided by the return guide **157** to the first guide shape **152**. Accordingly, the lever member **138**, fixing member **139** and switch gear **121** move to the positions shown in FIGS. **14**, **15**.

As described above, the guide member **92** placed in the carriage **38** moves the position of the lever **141**. Accordingly, the position of the switch gear **121** is changed. Specifically, the gear that switch gear **121** engages with is switched between the driven gears **123** through **126**. Specifically, the transmission destination to which the driving force transmitting device **220** transmits the driving force is switched.

<Structures of the Driven Gears **123** Through **126**>

The structures of the driven gears **123** through **126** are described next. The driven gears **123** through **126** are pinion gears. FIG. **23** and FIG. **24** are perspective views showing the driven gears **123** through **126**. Also, FIG. **25** shows a cross-sectional view of a state in which the set of driven gears (driven gears **123** through **126**) are placed.

A shaft hole **160** is formed on the first driven gear **123**. The shaft **122** (illustration thereof is omitted in FIG. **23** through FIG. **25**. See FIG. **10**) is inserted into the shaft hole **160**. The first driven gear **123** can rotate around the shaft **122**. On a side face of the first driven gear **123**, on the same side as the second driven gear **124**, there is a cylinder **161** protruding from the side face. The cylinder **161** is formed around the axis hole **160** so as to be concentric with the axis hole **160**. A contact surface **164** is formed on a side face on a periphery of the cylinder **161**. Moreover, on other side face of the first driven gear **123**, there is a cylinder **161***a* protruding from the side face. An end surface of the cylinder **161***a* is in contact with a member which is not shown.

A shaft hole **165** is formed on the fourth driven gear **126**. The shaft **122** is inserted into the shaft hole **165**. The fourth driven gear **126** can rotate around the shaft **122**. On a side face of the fourth driven gear **126**, on the same side as the third driven gear **125**, there is a cylinder **166** protruding from the side face. The cylinder **166** is formed around the shaft hole **165** so as to be concentric with the shaft hole **165**. The diameter of the cylinder **166** is larger than the diameter of the cylinder **161** of the first driven gear **123**. As shown in FIG. **25**, an end surface **171** of the cylinder **166** is in contact with an end surface **170** of the cylinder **161** of the first driven gear **123**. Moreover, a contact surface **169** is formed on a side face on a periphery of the cylinder **166**. Also, on other side face of the fourth driven gear **126**, there is a cylinder **165***a* protruding from the side face. An end surface of the cylinder **165***a* is in contact with a member which is not shown.

As described above, the end surface of the cylinder **165***a* is in contact with the unshown member, the end surface **171** of the cylinder **166** is in contact with the end surface **170** of the cylinder **161** of the first driven gear **123**, and the end surface of the cylinder **161***a* of the first driven gear **123** is in contact with the unshown member. Accordingly, the position in the direction parallel to the rotation axis of the first driven gear **123** and fourth driven gear (the position in the X direction shown in FIG. **26**, which is referred to as "axial direction" hereinafter), and the position in the axial direction of the fourth driven gear **126** are fixed.

A shaft hole **162** is formed in the center of the second driven gear **124**. The diameter of the shaft hole **162** is larger than the diameter of an outer periphery of the cylinder **161** of the first driven gear **123** by a predetermined amount. As shown in FIG. **25**, the cylinder **161** of the first driven gear **123** is inserted into the shaft hole **162**. Specifically, the second driven gear **124** is placed so as to be able to rotate around the cylinder **161**. On a side face of the second driven gear **124**, on the same side as the first driven gear **123**, there is a cylinder **163** protruding from the side face. The cylinder **163** is formed around the shaft hole **162** so as to be concentric with the shaft hole **162**. Furthermore, on a side face of the second driven gear **124**, on the same side as the third driven gear **125**, there is a cylinder **172** protruding from the side face. The cylinder **172** is formed around the shaft hole **162** so as to be concentric with the shaft hole **162**. As shown in FIG. **25**, the second driven gear **124** is placed such that the cylinders **163**, **172** are positioned between the contact surface **164** of the first driven gear **123** and the end surface **171** of the cylinder **166** of the fourth driven gear **126**. Accordingly, the position of the second driven gear **124** in the axial direction is fixed.

A shaft hole **167** is formed in the center of the third driven gear **125**. The diameter of the shaft hole **167** is larger than the diameter of an outer periphery of the cylinder **166** of the fourth driven gear **126** by a predetermined amount. As shown in FIG. **25**, the cylinder **166** is inserted into the shaft hole **167**. Accordingly, the third driven gear **125** is supported so as to be able to rotate around the cylinder **166**. On a side face of the third driven gear **125**, on the same side as the fourth driven gear **126**, there is formed a cylinder **168** protruding from the side face. The cylinder **168** is formed around the shaft hole **167** so as to be concentric with the shaft hole **167**. As shown in FIG. **25**, the third driven gear **125** is placed between the fourth driven gear **126** and the second driven gear **124**. Accordingly the position of the third driven gear **125** in the axial direction is fixed.

<Structure of Driven Gears of a Low-Level Type of the Complex Machine **1**>

As described above, the complex machine **1** is the highest level machine type in the series. Therefore, there exists a complex machine which is of a lower level than that of the complex machine **1**. A complex machine **1***a*, which is lower than the complex machine **1** by one grade, has a normal printing function, high-speed printing function and purging operation function, but does not have the feeding tray **11**. Also, a complex machine **1***b*, which is a lower grade than that of the complex machine **1***a*, has the normal printing function and purging operation function, but has neither the high-speed printing function nor feeding tray **11**. The structures of the complex machines **1***a* and **1***b* are very similar to that of the complex machine **1** except for the abovementioned differences. The structures of driven gears of the complex machines **1***a*, **1***b* are described hereinafter.

The complex machine **1***a* does not have the feeding tray **11**. Therefore, the complex machine **1***a* is constructed without the feeding tray **11** of the complex machine **1** and the mechanism for sending a paper from the feeding tray **11**. Therefore, the set of driven gears in the complex machine **1***a* is configured without the third driven gear **125** which appears in the set of driven gears for the complex machine **1**. FIG. **26** shows the set of driven gears of the complex machine **1***a*. As shown in FIG. **26**, the set of driven gears of the complex machine **1***a* have the driven gears **123**, **124** and **126**, but do not have the third driven gear **125**. In these circumstances, an end surface of the cylinder **165***a* of the fourth driven gear **126** is in contact with a member which is not shown, the end surface **171** of the cylinder **166** of the fourth driven gear **126** is in contact with the end surface **170** of the cylinder **161** of the first driven gear **123**, and an end surface of the cylinder **161***a* of the first driven gear **123** is in contact with a member which is not shown. Therefore, the first driven gear **123** and the fourth driven gear **126** can rotate without moving along the axial direction. Moreover, the second driven gear **124** is placed so that the cylinders **163**, **172** are positioned between the contact surface **164** of the first driven gear **123** and the end surface **171** of the cylinder **166** of the fourth driven gear **126**. Therefore, the second driven gear **124** can rotate without moving alone the axial direction.

As described above, in the complex machine **1***a*, even without the third driven gear **125**, the positions of the driven gears **123**, **124** and **126** in the axial direction are fixed. Therefore, the driven gears **123**, **124** and **126** can rotate without moving along the axial direction. Specifically, it is not necessary to provide a spacer in the space generated by removing the third driven gear **125** (the space between the second driven gear **124** and the fourth driven gear **126**).

The complex machine **1***b* does not have the feeding tray **11**. Therefore, the complex machine **1***b* is constructed without the feeding tray **11** of the complex machine **1**, the mechanism for sending a sheet of paper from the feeding tray **11**, and the mechanism for transmitting driving force to the second feeding roller **89** for performing high-speed printing. Therefore, the set of driven gears in the complex machine **1***b* are configured without the driven gears **124** and **125** which appear in the set of driven gears for the complex machine **1**. FIG. **26** shows the set of driven gears of the complex machine **1***b*. As shown in FIG. **26**, the set of driven gears of the complex machine **1***b* has the driven gears **123** and **126**, but does not have the driven gears **124** and **125**. In these circumstances, the end surface of the cylinder **165***a* of the fourth driven gear **126** is in contact with a member which is not shown, the end surface **171** of the cylinder **166** of the fourth driven gear **126** is in contact with the end surface **170** of the cylinder **161** of the first driven gear **123**, and the end surface of the cylinder **161***a* of the first driven gear **123** is in contact with a member which is not shown. Therefore, the first driven gear **123** and the fourth driven gear **126** can rotate without moving along the axial direction.

As described above, in the complex machine **1***b*, even without the driven gears **124** and **125**, the positions of the driven gears **123** and **126** in the axial direction are fixed. Therefore, the driven gears **123** and **126** can rotate without moving along the axial direction. Specifically, it is not necessary to provide a spacer in a space generated by removing the driven gears **124** and **125** (a space between the first driven gear **123** and the fourth driven gear **126**).

As described above, according to the set of driven gears of the complex machine **1** of the present embodiment, each of the driven gears **123** through **126** can rotate without moving along the axial direction.

Also, according to the set of driven gears of the complex machine **1**, even without the third driven gear **125**, the positional relationship among the first driven gear **123**, the second driven gear **124** and the fourth driven gear **126** in the axial direction does not change. Therefore, when placing the set of driven gears in the complex machine **1***a* without providing the third driven gear **125**, it is not necessary to provide a spacer in place of the third driven gear **125**.

Moreover, according to the set of driven gears of the complex machine **1**, even without the second driven gear **124** and the third driven gear **125**, the positional relationship between the first driven gear **123** and the fourth driven gear **126** in the axial direction does not change. Therefore, when placing the set of driven gears in the complex machine **1***b* without providing the second driven gear **124** and third driven gear **125**, it is not necessary to provide a spacer in place of the second driven gear **124** and third driven gear **125**.

In the above-described complex machine **1**, the fourth driven gear **126** transmits larger driving force, than the other driven gears. Since the cylinder **166** is formed on the fourth driven gear **126**, the contact area between the fourth driven gear **126** and the shaft **122** is large. As a result of the larger contact area between the fourth driven gear **126** and the shaft **122**, the fourth driven gear **126** can transmit larger driving force. It should be noted that, in the complex machine **1**, the area of contact between the first driven gear **123** and the shaft **122** is also large. Therefore, a larger driving force may also be transmitted to the first driven gear **123**.

The specific examples of the present invention are described in detail above, but these specific examples are merely examples and thus do not limit the scope of claims. The technologies of the present invention include the matters in which the above-described specific examples are modified and changed in various ways.

The technical elements described in the present specification and drawings achieve the technical utility independently or by combining these technical elements in various ways, and thus are not limited to the combinations which are described in the claims upon filing. Moreover, the technologies described in the present specification and drawings are to achieve a plurality of objects simultaneously and achieve the Technical utility by achieving one of the objects.

What is claimed is:

1. A printer, comprising:

a switch gear comprising a switch spur gear and being slidable along a direction that is parallel to a rotation axis of the switch spur gear;

a first driven gear comprising a first spur gear and a cylinder fixed to the first spur gear, the cylinder being concentric with respect to the first spur gear and extending along said direction, the first driven gear engaging with a first mechanism;

a second driven gear comprising a second spur gear with a hole that is concentric with respect to the second spur gear and extends along said direction, the second driven gear engaging with a second mechanism different from the first mechanism;

a sliding power source which generates a power for sliding the switch gear;

a slide mechanism configured to receive the power for sliding the switch gear generated by the sliding power source and to slide the switch gear along said direction; and

a first tray for storing sheets,

wherein the second driven gear is mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear and is rotatable with respect to the first driven gear around the cylinder,

the slide mechanism slides the switch gear between a first position where teeth of the switch gear engage with teeth of the first spur gear and a second position where the teeth of the switch gear engage with teeth of the second spur gear along said direction, and

the first mechanism is configured to feed the sheets from the first tray by receiving a first drive power transmitted via the first driven gear.

2. The printer as defined in claim **1**, further comprising:

a third driven gear comprising a third spur gear with a hole that is concentric with respect to the third spur gear and extends along said direction, the third driven gear engaging with a third mechanism; and

a fourth driven gear comprising a fourth spur gear and a cylinder fixed to the fourth spur gear, the cylinder of the fourth driven gear being concentric with respect to the fourth spur gear and extending along said direction, the fourth driven gear engaging with a fourth mechanism,

wherein the third driven gear is mounted on the fourth driven gear by inserting the cylinder of the fourth driven gear into the hole of the third driven gear and rotatable with respect to the fourth driven gear around the cylinder of the fourth driven gear,

a distal end of the cylinder of the first driven gear is in contact with a distal end of the cylinder of the fourth driven gear, and

the slide mechanism slides the switch gear among positions comprising the first position, the second position, a third position where the teeth of the switch gear engage with teeth of the third spur gear, and a fourth position where the teeth of the switch gear engage with teeth of the fourth spur gear, along said direction.

3. The printer as defined in claim **1**,

wherein the first mechanism comprises gears and the second mechanism comprises gears,

a part of the gears of the first mechanism can rotate independently from the gears of the second mechanism, and a part of the gears of the second mechanism can rotate independently from the gears of the first mechanism.

4. A printer, comprising:

a switch gear comprising a switch spur gear and being slidable along a direction that is parallel to a rotation axis of the switch spur gear;

a first driven gear comprising a first spur gear and a cylinder fixed to the first spur gear, the cylinder being concentric with respect to the first spur gear and extending along said direction, the first driven gear engaging with a first mechanism;

a second driven gear comprising a second spur gear with a hole that is concentric with respect to the second spur gear and extends along said direction, the second driven gear engaging with a second mechanism different from the first mechanism;

a third driven gear comprising a third spur gear with a hole that is concentric with respect to the third spur gear and extends along said direction, the third driven gear engaging with a third mechanism;

a fourth driven gear comprising a fourth spur gear and a cylinder fixed to the fourth spur gear, the cylinder of the fourth driven gear being concentric with respect to the fourth spur gear and extending along said direction, the fourth driven gear engaging with a fourth mechanism;

a sliding power source which generates a power for sliding the switch gear; and

a slide mechanism configured to receive the power for sliding the switch gear generated by the sliding power source and to slide the switch gear along said direction,

wherein the second driven gear is rotatably mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear,

the third driven gear is rotatably mounted on the fourth driven gear by inserting the cylinder of the fourth driven gear into the hole of the third driven gear,

a distal end of the cylinder of the first driven gear is in contact with a distal end of the cylinder of the fourth driven gear,

a diameter of the cylinder of the first driven gear is smaller than a diameter of the cylinder of the fourth driven gear,

the second driven gear is interposed between the first spur gear and the cylinder of the fourth driven gear,

the third driven gear is interposed between the second driven gear and the fourth spur gear, and

the slide mechanism slides the switch gear among positions comprising a first position where the switch gear engages with the first driven gear, a second position where the switch gear engages with the second driven gear, a third position where the switch gear engages with the third driven gear, and a fourth position where the switch gear engages with the fourth driven gear, along said direction.

5. A printer, comprising:

a switch gear comprising a switch spur gear and being slidable along a direction that is parallel to a rotation axis of the switch spur gear;

a first driven gear comprising a first spur gear and a cylinder fixed to the first spur gear, the cylinder being concentric with respect to the first spur gear and extending along said direction, the first driven gear engaging with a first mechanism;

a second driven gear comprising a second spur gear with a hole that is concentric with respect to the second spur gear and extends along said direction, the second driven gear engaging with a second mechanism different from the first mechanism;

a third driven gear comprising a third spur gear with a hole that is concentric with respect to the third spur gear and extends along said direction, the third driven gear engaging with a third mechanism;

a fourth driven gear comprising a fourth spur gear and a cylinder fixed to the fourth spur gear, the cylinder of the fourth driven gear being concentric with respect to the fourth spur gear and extending along said direction, the fourth driven gear engaging with a fourth mechanism;

a sliding power source which generates a power for sliding the switch gear;

a slide mechanism configured to receive the power for sliding the switch gear generated by the sliding power source and to slide the switch gear along said direction;

a first tray for storing sheets;

a second tray for storing sheets; and

an inkjet head for discharging ink droplets,

wherein the second driven gear is rotatably mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear,

the third driven gear is rotatably mounted on the fourth driven gear by inserting the cylinder of the fourth driven gear into the hole of the third driven gear,

a distal end of the cylinder of the first driven gear is in contact with a distal end of the cylinder of the fourth driven gear,

the slide mechanism slides the switch gear among positions comprising a first position where the switch gear engages with the first driven gear, a second position where the switch gear engages with the second driven gear, a third position where the switch gear engages with the third driven gear, and a fourth position where the switch gear engages with the fourth driven gear, along said direction, and wherein:

the first mechanism is configured to intermittently feed the sheets from the first tray by receiving a first drive power transmitted via the first driven gear;

the second mechanism is configured to continuously feed the sheets from the first tray by receiving a second drive power transmitted via the second driven gear;

the third mechanism is configured to feed the sheets from the second tray by receiving a third drive power transmitted via the third driven gear; and

the fourth mechanism is configured to execute maintaining the inkjet head by receiving a fourth drive power transmitted via the fourth driven gear.

6. A printer comprising:

a switch gear comprising a switch spur gear and being slidable along a direction that is parallel to a rotation axis of the switch spur gear;

a first driven gear comprising a first spur gear and a cylinder fixed to the first spur gear, the cylinder being concentric with respect to the first spur gear and extending along said direction, the first driven gear engaging with a first mechanism;

a second driven gear comprising a second spur gear with a hole that is concentric with respect to the second spur gear and extends along said direction, the second driven gear engaging with a second mechanism different from the first mechanism;

a sliding power source which generates a power for sliding the switch gear;

a slide mechanism configured to receive the power for sliding the switch gear generated by the sliding power source and to slide the switch gear along said direction; and

an inkjet head for discharging ink droplets, wherein the second driven gear is mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear and is rotatable with respect to the first driven gear around the cylinder,

the slide mechanism slides the switch gear between a first position where teeth of the switch gear engage with teeth of the first spur gear and a second position where the teeth of the switch gear engage with teeth of the second spur gear along said direction, and

the slide mechanism comprises a carriage that mounts the inkjet head and reciprocates along said direction.

7. A set of driven gears commonly used for manufacturing a first type of printer comprising a first and a fourth mechanism, a second type of printer comprising the first, a second and the fourth mechanism, and a third type of printer comprising the first, the second, a third and the fourth mechanism, the set of driven gears comprising:

a first driven gear for engagement with the first mechanism;

a second driven gear for engagement with the second mechanism;

a third driven gear for engagement with the third mechanism; and

a fourth driven gear for engagement with the fourth mechanism,

wherein the first driven gear comprises a first spur gear and a cylinder fixed to the first spur gear, the cylinder of the first driven gear being concentric with respect to the first spur gear and extending along a direction that is parallel to a rotation axis of the first spur gear,

the second driven gear comprises a second spur gear with a hole that is concentric with respect to the second spur gear and extends along a direction that is parallel to a rotation axis of the second spur gear,

the third driven gear comprises a third spur gear with a hole that is concentric with respect to the third spur gear and extends along a direction that is parallel to a rotation axis of the third spur gear,

the fourth driven gear comprises a fourth spur gear and a cylinder fixed to the fourth spur gear, the cylinder of the fourth driven gear being concentric with respect to the fourth spur gear and extending along a direction that is parallel to a rotation axis of the fourth spur gear,

the first and fourth driven gears are used for manufacturing the first type of printer in a condition that a distal end of the cylinder of the first driven gear is in contact with a distal end of the cylinder of the fourth driven gear,

the first, second and fourth driven gears are used for manufacturing the second type of printer in a condition that the distal end of the cylinder of the first driven gear is in contact with the distal end of the cylinder of the fourth driven gear, and the cylinder of the first driven gear is inserted into the hole of the second driven gear, and

the first, second, third and fourth driven gears are used for manufacturing the third type of printer in condition that the distal end of the cylinder of the first driven gear is in contact with the distal end of the cylinder of the fourth driven gear, the cylinder of the first driven gear is inserted into the hole of the second driven gear, and the cylinder of the fourth driven gear is inserted into the hole of the third driven gear.

8. The set of driven gears as defined in claim **7**,

wherein the first, second and fourth driven gears are used for manufacturing the second type of printer in a condition that the second driven gear is rotatable with respect to the first driven gear around the cylinder of the first driven gear, and

the first, second, third and fourth driven gears are used for manufacturing the third type of printer in a condition that the second driven gear is rotatable with respect to the first driven gear around the cylinder of the first driven gear, and the third driven gear is rotatable with respect to the fourth driven gear around the cylinder of the fourth driven gear.

9. A printer comprising:

a switch gear comprising a switch spur gear and being slidable along a direction that is parallel to a rotation axis of the switch spur gear;

a first driven gear comprising a first spur gear and a cylinder fixed to the first spur gear, the cylinder being concentric with respect to the first spur gear and extending along said direction, the first driven gear engaging with a first mechanism;

a second driven gear comprising a second spur gear with a hole that is concentric with respect to the second spur gear and extends along said direction, the second driven gear engaging with a second mechanism different from the first mechanism;

a sliding power source which generates a power for sliding the switch gear;

a slide mechanism configured to receive the power for sliding the switch gear generated by the sliding power source and to slide the switch gear along said direction; and

an inkjet head for discharging ink droplets,

wherein the second driven gear is mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear and is rotatable with respect to the first driven gear around the cylinder,

the slide mechanism slides the switch gear between a first position where teeth of the switch gear engage with teeth of the first spur gear and a second position where the teeth of the switch gear engage with teeth of the second spur gear along said direction, and

the first mechanism is configured to execute maintaining the inkjet head by receiving a first drive power transmitted via the first driven gear.

10. A printer comprising:

a switch gear comprising a switch spur gear and being slidable along a direction that is parallel to a rotation axis of the switch spur gear;

a first driven gear comprising a first spur gear and a cylinder fixed to the first spur gear, the cylinder being concentric with respect to the first spur gear and extending along said direction, the first driven gear engaging with a first mechanism;

a second driven gear comprising a second spur gear with a hole that is concentric with respect to the second spur gear and extends along said direction, the second driven gear engaging with a second mechanism different from the first mechanism;

a sliding power source which generates a power for sliding the switch gear;

a slide mechanism configured to receive the power for sliding the switch gear generated by the sliding power source and to slide the switch gear along said direction; and

a roller,

wherein the second driven gear is mounted on the first driven gear by inserting the cylinder of the first driven gear into the hole of the second driven gear and is rotatable with respect to the first driven gear around the cylinder, the slide mechanism slides the switch gear between a first position where teeth of the switch gear engage with teeth of the first spur gear and a second position where the teeth of the switch gear engage with teeth of the second spur gear along said direction, and

the roller rotates to a first rotational direction when the switch gear rotates to a predetermined rotational direction at the first position, the roller rotates to a second rotational direction opposite to the first rotational direction when the switch gear rotates to the predetermined rotational direction at the second position.

* * * * *